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COGNITIVE COMPLEXITY AND CLASSIFICATION RULE LEARNING

by

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The undersigned certify that they have read and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled "Cognitive Complexity and Classification Rule Learning" submitted by Archibald C. Bower in partial fulfilment of the requirements for the degree of Doctor of Philosophy.

ABSTRACT

This investigation attempted three things: (1) to test Schroder's assumption that individuals high in cognitive complexity are able to generate and/or utilize more complex rules than cognitively simple individuals; (2) to assess the value of a short form of the Interpersonal Topical Inventory (ITI), a multidimensional scaling technique and a classification rule learning task as measures of cognitive complexity; and (3) to investigate a number of possible correlates of cognitive complexity.

The first purpose was realized by comparing members of the four conceptual systems in a classification rule learning task that was under computer control. Subjects were classified according to Harvey's Conceptual Systems Test (CST) and each subject received a different order of three rules (inclusive disjunction, joint denial, biconditional), each with three problems. The results offered only very tentative support for Schroder's position. Rules and ordinal position of problems were significantly different. Also, unique error sources were associated with each rule.

The second and third purposes of this study were accomplished by administering the complexity measures and their personality correlates to a large class of students. The results indicated that the CST and other complexity

measures were orthogonal to one another. This was explained in terms of domain specific complexity. Further, analyses of variance between groups based on the CST found theoretically consistent differences for the variables of internal-external control, intrinsicness, use of a theological model of behavior, and several scales of the Myers-Briggs Type Indicator. A number of these measures also loaded in the predicted direction on a factor which included the CST.

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CHAPTER I

INTRODUCTION

Educators have exerted considerable energy in the investigation of environmental as well as teacher and student characteristics considered relevant to classroom learning (Biddle and Ellena, 1964; Gage, 1963). Recently some researchers (Harvey, Prather, White, and Hoffmeister, 1968; Hunt and Joyce, 1967; Joyce, Lamb, and Sibol, 1966) have shown that the complexity of cognitive structures is significantly related to teacher and student behavior. These cognitive structures or the "filters" through which individuals view the world largely determine their capacity for processing information. Thus it seems quite probable that the cognitive complexity of teachers and students may be a significant new classroom variable.

Several authors have given the concept of cognitive complexity a central place in their thinking. Hunt (1966) asserts that the chief goal of education is to modify the cognitive structures of pupils. He writes that ". . . the aim of education is to produce persons who are questioning, inventive, original, critical, creative, and if need be, different" (Ibid., p. 289). Joyce and Harootunian (1967) outline a theory of teaching behavior for which the concept of cognitive complexity and associated concepts such as flexibility, creativity, and open-mindedness are central. Also, in a discussion of Galbraith's (1967) book, the New

Industrial State, Anderson (1968) points out the possibility that a particular type of education can be a bulwark against domination by the technostructure. Thus, he believes that the goal of education must be to develop individuality, pluralism, autonomy and flexibility (that is, more complex cognitive structures) rather than the compliant, conforming and cognitively simple person that the technostructure seeks to produce by way of advertising in the mass media.

The empirical evidence also indicates that the level of cognitive complexity is a critical variable affecting teacher performance. Joyce, Lamb, and Sibol (1966) examined the ways in which teachers high and low in complexity processed information about children. The teachers were required to read short case histories about students, before responding to diagnostic and remedial statements about them. They found that the abstract subjects became more certain as they received more information, but that the concrete subjects tended to be certain from the start. The authors comment that the reason why teacher trainees are often unable to make effective decisions when presented with behavioral data may well be due to cognitive simplicity. Support for this contention comes from Harvey et al, (1968, p. 155) who found fifty out of sixty-seven elementary teachers belonging to System 1 (very concrete) while only eight were "weak instances" of System 4 (highly complex).

Research by Harvey and associates (Harvey, White,

Prather, Alter and Hoffmeister, 1966; Harvey *et al.*, 1968) in Colorado has also related the degree of cognitive complexity to desirable aspects of teacher and student behavior. They found that abstract teachers were more resourceful, less dictatorial and less punitive than concrete teachers. In their 1968 study they report the students of abstract teachers to be more involved, more active, higher in achievement and more abstract than those of concrete teachers. Hunt and Joyce (1967) also found a positive relationship between the abstractness of a trainee's conceptual system and an initially reflective and adaptable teaching style.

There is also some indication that the cognitive complexity variable may offer a new way of grouping pupils. Hunt (1966), in order to support his conceptual change model, mentions a study in which ninth grade pupils were classified into conceptual systems. These involved three groups: Sub. I, low abstractness, high negativism; Stage I, moderate abstractness, low negativism; and Stage II, high abstractness, moderate negativism. Their classroom behavior was consistent with complexity theory (Harvey, Hunt, and Schroder, 1961) and Hunt also indicates that the teachers preferred different teaching procedures for each group. In a later study Hunt and Hardt (1967) showed that students who were lowest in complexity performed best in a structured classroom whereas students highest in complexity learned best in a more flexible atmosphere. This finding also implies that teachers could be matched with

classrooms on the basis of their conceptual level. Thus, it does appear that complexity theory has some important implications for the educational scene, especially as a means of screening teacher trainees and matching pupils with teachers.

Unfortunately, however, there are a number of serious problems and uncertainties associated with this concept. These are chiefly concerned with the lack of consensus in the definition and measurement of the construct. For example, Harvey (1966) retains the original meaning (Harvey _et al._, 1961, pp. 24-28) as referring to a dimension of concrete-abstract behavior. But, he also believes that individuals can be classified into four systems on the basis of certain attitudes, beliefs, and behaviors. Bieri (1966) writes that "cognitive complexity may be defined as the tendency to construe social behavior in a multi-dimensional way. . ." (p. 14). Scott (1962) seems to focus on the differentiation among concepts. For him cognitive complexity is a function of ". . . the number of distinct frames of reference. . ." (p. 90), that a person uses in perceiving objects. Finally, Schroder and his associates (Schroder, Driver, and Streufert, 1967, p. 7) have adopted a definition, in terms of dimensions and rules for relating them, which they denote as integrative complexity.

Apart from the differences in definition there are serious measurement problems (Bieri, 1961, 1966; Jaspers

1963; Scott, 1963). For instance, Scott observed that his test (Groups of Nations Test) probably has little relation to the Rep Test used by Bieri. Schroder et al. (1967) utilized a semi-projective test, the Paragraph Completion Test (PCT). However, they make no attempt to show that the PCT has any conceptual or statistical connection with their definition of complexity. Further, only in an occasional and easily-ignored statement do they suggest the possibility that this test measures only one aspect of the domain of conceptual structure, the interpersonal one. Some other problems will be mentioned later.

Although the author was quite aware of the problems besetting the complexity dimension, an attempt was made to seek some clarity and precision, if only because it does have relevance to the educational scene. Accordingly, three areas were chosen for investigation. First of all, this study sought to test Schroder's assumption that individuals high in cognitive complexity are able to generate and utilize more complex schemata or rules in their processing of information than are individuals low in complexity. This was done by having subjects varying in conceptual level solve classification rules in a computer--based experiment. A second purpose of this study was to assess the value of several measures of cognitive complexity. These tests included a short form of the Interpersonal Topical Inventory

(Gardiner, 1968), a multidimensional scaling approach and the use of classification rule learning. A third intention of this study was to examine some personality correlates of the complexity dimension.

CHAPTER II

LITERATURE RELEVANT TO COGNITIVE COMPLEXITY AND RULE LEARNING

Cognitive Complexity

The concept of cognitive complexity refers to the degree of differentiation and integration inherent in cognitive structures.[1] Harvey (1966, 1967), Schroder, Driver, and Streufert (1967) and Tuckman (1966) consider that the complexity of these structures is due to two factors. One is the number of dimensions available for differentiating or interpreting stimulus input. The other refers to the number and organization of the schemata (rules) used to generate hierarchical structures among the dimensions. Correlated with the increasing complexity of cognitive structure is increasing abstractness in behavior (Harvey, 1966, p. 43; Schroder *et al.*, pp. 15-23). This dimension appears similar to that recently described by Jeffrey (1968): there is a movement from an immediate and involuntary adaptive response to the external world to a level where it is possible to transcend and depart from the immediate and perceptual characteristics of the external world. At the highest level of abstractness,

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[1]This thesis uses the term "cognitive complexity" to a large degree, but considers it to be essentially synonymous with Schroder's "integrative complexity," Harvey's "conceptual systems theory," and with Hunt's "conceptual level."

Schroder *et al.*, (1967, p. 22) suggest that there is a reliance on internal processes which can produce alternate organizations of rules for processing information.

Harvey, Hunt, and Schroder (1961), posit four stages or nodal points of cognitive complexity which fall along this continuum from concreteness to abstractness. They also deduce several intermediate stages which are admixtures of the more proximal major systems, but which are related to progression. The four major systems or stages represent a degree of arrestation or closedness. Each tends to be concerned with some characteristic object or theme.

System 1, the most concrete level of functioning manifests characteristics such as high absolutism, closedness of beliefs, high dependence on authority, high conventionality and strong ethnocentrism. There is a high similarity to the authoritarianism syndrome. System 1 functioning seems to be a result of early association with dogmatic and punitive training agents who imposed standards of conduct and belief and disallowed free exploration of the environment.

System 2, functioning, superior to System 1 in abstractness, is characterized by deep feelings of uncertainty, distrust, and rejection of authority, and rejection of socially accepted standards of conduct. There is a high drive towards autonomy and avoidance

of dependency on God, tradition, and other positive guides (for System 1 individuals). System 2 behavior is assumed to develop from arbitrary child-rearing practices, which fail to provide any predictable referent points in the child's world, while allowing him diversity far in excess of the ideal.

System 3, individuals are assumed to develop in an atmosphere of over-protection and over-indulgence, which prevents them from exploring their physical surroundings. Rather they learn how to manipulate others through depending upon them. Thus, individuals functioning at the System 3 level can effect desired outcomes by manipulating others. Nevertheless, some autonomous internal standards along with positive ties to the social norms develop, although they are still incapable of complete independence.

System 4, functioning which is at the most abstract end of the continuum, is characterized by highly differentiated and integrated cognitive structures. Consequently, these individuals are more flexible, creative, and more relative in thought and behavior. They are guided by internal standards that are largely free of external criteria and conventions. System 4, functioning is seen as a consequence of freedom in childhood to explore the total environment, to establish values based upon their own experience, and to solve problems without fear of punishment.

This theorizing has received some support from recent investigations into the determinants of complexity. For example, Adams, Harvey, and Heslen (1966) found that by hypnotically inducing the childhood histories associated with the different systems they could influence their subjects' performance. Cross (1966) and Harvey (1966) obtained some support for specific childhood training experiences by questionnaires.

Considerable research is available to show that individuals who differ in their level of cognitive complexity also differ over a broad spectrum of behaviors. For example, the level of cognitive complexity has been shown to relate to decision making behavior (Sieber and Lanzetta, 1964; 1966; Stager, 1967); the toleration of stress (Driver, 1962; Harvey and Ware, 1967); problem solving (Felknor and Harvey, 1964; Karlins, Coffman, Lamb and Schroder, 1967; and Sieber, 1964); and person perception and impression formation (Carr, 1965; Crockett, 1965). Harvey (1966, pp. 54-55) reports that the conceptual levels differ in cue utilization; in the ability to change set as measured by the Gottschaldt Embedded Figures Test and the Denny Doodle-bug Problem; in the production of novel but appropriate responses (creativity); and the admission of deviant inputs (Ibid., pp. 58-59). Finally, as previously noted, reports by Harvey, Prather, White and Hoffmeister (1968), Hunt and Joyce (1967) and Joyce, Lamb, and Sibol (1966) all indicate that the level

of a teacher's cognitive complexity is related to his performance in the classroom and hence affects the cognitive development of his students.

Schroder has apparently departed from placing individuals into the four systems as Harvey does (Schroder _et_ _al_., 1967). His interest is now focused upon a dimension of integrative complexity. For Schroder the rules used for information processing are basic to the level of integrative complexity that is achieved. Rules are even more central than the degree of differentiation of a system. Dimensionality has only a low-order relationship to the level of integration (Schroder _et_ _al_., p. 14) whereas the rules are positively related to the complexity of a system.

Schroder _et_ _al_., (1967) describe verbally and pictorially the levels of cognitive integration. At the lowest level ". . . intervening structures are characterized by compartmentalization and by a hierarchical integration of parts (rules). Regardless of the number of dimensions or the number of rules . . . the integrating structure is absolute." (p. 15). Thus, rules serve the function of categorizing stimuli, for purposes of structure and order.

At a slightly higher level of integration, rules are utilized to combine two or more dimensional values. A mother helping a child to dress could be coded as "plus" or "minus" on the control dimension ". . . depending on

which of the alternate sets of rules the judgment was anchored" (p. 18). At this level schemata are related in a most primitive way with the integrating rules loosely specifying conditionality. That is, in situation X, weight rule A more than rule B or C.

According to Schroder et al., (1967) more complex and interrelated schemata emerge at the third level. The rules are able to " . . . identify more complex relations than alternation . . ." (p. 20). Rules are available for matching, comparing, and relating pairs of schemata. This leads to the awareness of "self" as a causative agent in behavior (p. 22).

Finally, at the level of highest integration there are ". . . additional and more complex potentialities for organizing additional schemata in alternate ways" (p. 22). Rules for comparison can be further integrated and they open up the possibility for highly abstract functioning. In contrast to the lowest level of integration, which has a hierarchical set of established rules and procedures, the highest level of functioning permits generation of new rules and relationships.

The Schroderian rules that determine integration level may be described as categorical, conditional, and comparative or relational. At the highest level of integration are more rules for comparison which appear to be internally generated. However, this description of the rules involved in information processing can only be

considered as speculative. More precise identification of the rules involved is surely required.

Schroder and his associates have presented little empirical evidence to clarify the nature of rules involved in information processing. In fact, they have not shown that individuals at different stages of cognitive complexity actually differ in rule utilization or formation. They have often used the Paragraph Completion Test (PCT) to classify individuals into high and low groups, but never have they attempted to show that these groups differ in their effectiveness as rule utilizers or learners. Even in the study by Schroder and Blackman (1965) there is a failure to test the assumptions concerning the rules used by the different conceptual systems. While they successfully demonstrate the validity of rules of categorizing, weighting, and combination, they do not show that their use is related differently to variations in conceptual level. A discussion of logical rules will clarify matters and may even suggest a way in which Schroder's hypothesis can be tested.

Rule Learning

A number of recent studies (Bourne, 1967; Haygood and Bourne, 1965; King, 1966) have dealt with the learning and utilization of logical rules. The clearly specifiable rules that these researchers have used are taken from symbolic logic (Basson and O'Connor, 1953). At the simplest

level are the primitive rules or "connectives" of negation, conjunction, and disjunction, out of which more complex rules can be developed. For instance, by using these "connectives" and two stimulus dimensions (for example, colour and shape) it is possible to partition a stimulus population in sixteen unique ways. Some of these divisions are trivial, but others include such important rules as conditional, biconditional, inclusive disjunction, joint denial and conjunction.

In Table I are shown some of the more important classification rules along with their symbolic description and the manner in which they assign two focal attributes (for example, red and triangle) to a binary response system. In the table, A and B stand for different attributes, for example, large and square. Under the heading, "Truth Table Value," the letter P is used to indicate the presence of an attribute and A is used to indicate its absence. The first letter in the pair PA means that attribute A (largeness) is present while the second letter means that attribute B (squareness) is absent from the stimulus. A "1" indicates that the rule holds for that particular attribute contingency while "0" means that it does not hold.

Conceptual rules may be much more difficult than the bidimensional nominal ones mentioned so far. One of the easiest ways to increase their difficulty is to add dimensions. Hunt, Marin, and Stone (1966) in their

TABLE I

SOME BIDIMENSIONAL RULES AND THEIR TRUTH TABLE ASSIGNMENTS

Rule	Verbal Description	Truth Table Value PP	PA	AP	AA
1. Conjunction ($A \cdot B$)	Both A <u>and</u> B	1	0	0	0
2. Joint Denial ($\sim A \cdot \sim B$)	Absence of A <u>and</u> B	0	0	0	1
3. Inclusive Disjunction ($A \vee B$)	A <u>and/or</u> B	1	1	1	0
4. Conditional ($A \supset B$)	<u>If</u> A <u>then</u> B	1	0	1	1
5. Biconditional ($A \supset B \cdot B \supset A$)	<u>Both</u> A <u>and</u> B <u>or</u> <u>neither</u> A and B	1	0	0	1
6. Exclusive Disjunction ($A \wedge B$)	A <u>or</u> B	0	1	1	0

computer simulation of concept learning use three and four dimensional rules. For example, by changing their symbolism and letting A, B, C, and D stand for different attributes we have $A \cdot (B \vee C)$ or $(A \cdot B) \cdot (C \vee D)$ and so forth. Shepard, Hovland, and Jenkins (1961) and Neisser and Weene (1962) have shown that rules can be arranged in a hierarchical fashion largely on the basis of the connectives involved. For example, in order to solve a biconditional problem, knowledge of the primitive connectives of negation, conjunction, and disjunction are required.

However, human conceptual behavior and the study of it is not limited to nominal rules of classification. Relational rules (such as, larger than, in the centre, darker than) are certainly relevant to human information processing. Rules at the ordinal level have been studied by Haygood (1967) and Hunt and Hovland (1960). Probablistic rules in addition to nominal ones, were studied by Bruner, Goodnow, and Austin (1956). More recently, Uhl (1963) reported a study on the learning of interval concepts. Finally, Adams (1953) has argued for the extension of the notion of rules to include those of addition, subtraction, multiplication, and the like. For instance, the concept of addition may be depicted as follows: $R_{ij} = a_i + b_j$, where a_i and b_j are two values of stimulus dimensions A and B and R_{ij} is the response

Only recently has research on classification rule learning as such appeared in the literature. Although

Hunt (1962), in his survey of concept learning, discusses logical rules in relation to concepts and conducted an experiment on learning the connectives (Hunt and Kreuter, 1962), the first experimental study of classification rule learning is reported by Haygood and Bourne (1965). In this paper they show that conceptual behavior consists of two components: attribute identification and rule learning.

Attribute identification (AI) describes the situation in which a subject knows the rule but must discover the relevant attributes. Examples of AI are the studies by Bourne (1957), Bourne and Haygood (1959), Bruner et al.,(1956) Kepros and Bourne (1966) and Walker and Bourne (1961).

In studies of rule learning (RL) the subject knows the relevant attributes (usually two) and must learn a logical rule for classifying the stimuli correctly. Research utilizing this paradigm has been reported by Bourne (1967), Bourne and Guy (1968a,1968b), Bower and King (1967), Haygood and Devine (1967), Haygood and Stevenson (1967), and King (1966; 1968).

Finally, the situation where the subject is required to discover the relevant attributes and the rule is known as complete learning (CL). Most experiments in conceptual behavior have been of this type. Some examples are Cahill and Hovland (1960), Freibergs and Tulving (1961), Hovland and Weiss (1953), Hunt and Kreuter (1962), Neisser and Weene (1962), Shepard et al., (1961) and Wells (1963). In CL, of course, it is impossible to separate the effects of AI and

RL. In terms of difficulty, the order is CL, AI, and finally RL (Haygood and Bourne, 1965).

Compared to the number of studies done on concept learning, relatively few have been carried out using the RL paradigm. To date, most interest has centered upon differences among rules in difficulty (Bourne, 1967; Haygood and Bourne, 1965; King, 1966) and the reasons for this state of affairs (Bower and King, 1967; Haygood and Devine, 1967; King, 1968). Research in RL behavior has also involved manipulating the number of relevant and irrelevant dimensions (Bower and King, 1967; Haygood and Stevenson, 1967; Looney and Haygood, 1968); the proportion of PP instances (Haygood and Devine, 1967); and of AA instances (King, 1968); the effects of retaining (Bourne, 1967); age differences (King, 1966); and sex and verbalization (Bower and King, 1967). Haygood and Bourne (1965) and Haygood and Devine (1967) also compared RL performance with AI and CL.

Some Hypotheses

A number of hypotheses relevant to Schroder's assumptions about integrative complexity and rules can be developed from the previous discussion. It can be predicted that highly complex or abstract individuals will be significantly superior in a rule learning task, in terms of fewer errors, fewer trials, and less time to criterion, in contrast to individuals lower in cognitive complexity. This expectation is based upon Schroder's contention that individuals high in cognitive complexity are better able to generate and draw

upon complex rules. Thus, it can be expected that such individuals will be superior in an RL task.

Further, rules have been shown to differ in relative difficulty. Haygood and Bourne (1965) found the following order--from easiest to hardest: conjunction, inclusive disjunction, joint denial, conditional, and biconditional. Now, since individuals who are highly complex are supposed to utilize more complex integrative rules in their information processing than those low in cognitive complexity, it can be predicted that their superiority will be greatest for the most difficult rules. Support for this hypothesis also comes from findings (Schroder et al., 1967, Chapter 8) that as environmental complexity increases the curves for individuals high and low in complexity separate. This divergence reflects the fact that the highly complex individual can process more information input than the simple individual. Thus, in an RL task using simple rules such as affirmation and conjunction, little difference between groups high and low in cognitive complexity is to be expected, whereas with more difficult rules like conditional and biconditional group differences should become larger. Hence, an interaction between complexity groups and rule difficulty can be predicted.

In addition, it has frequently been reported that highly complex individuals delay decision making time by seeking more information (Karlins, et al., 1967; Sieber and Lanzetta, 1964, 1966). Apparently, they consider many

more alternatives than concrete individuals who are characterized by impulsive and sterotypic responses. Thus, assuming that the RL task is sufficiently difficult to discriminate among individuals it can be predicted that cognitively complex subjects will have a greater mean response time than less complex individuals.

Finally, studies in concept learning and language use have found that individuals have particular difficulty in using negative instances to solve problems (Hovland and Weiss, 1953; Freibergs and Tulving, 1961; Wason, 1959, 1960, 1961, 1962; Wells, 1963). Similarly, in RL the placement of some attribute contingencies causes more difficulty than others. For example, placing the AA instance into the positive category with the PP instance is a source of great difficulty in the case of the biconditional rule (Bower and King, 1967). Since individuals who are high in cognitive complexity are assumed to be less stimulus bound and more flexible than those low in complexity, they ought to have less difficulty in grouping apparently discordant instances together. More specifically, they should make fewer errors with the AA contingency in the biconditional rule and with the PP contingency in the joint denial rule.

CHAPTER III

THE MEASUREMENT AND CORRELATES OF COGNITIVE COMPLEXITY

Measuring Cognitive Complexity

Although several authors (Bieri, 1961, 1966; Jaspers, 1963, and Scott, 1963) have expressed concern about the measurement and definition of cognitive complexity, little consensus has been reached regarding the most appropriate instrument for this purpose. In fact, each researcher in the area seems to rely exclusively upon his own test which has seldom been validated against existing ones. For instance, Bieri and associates (1966) favour Kelly's Rep Test in their studies of social judgment. Tuckman (1966a) has developed the Interpersonal Topical Inventory for his research. As a measure of cognitive differentiation, Scott (1962, 1963) relies on his Groups of Nations Test. Harvey has generally used a semiprojective device known as the This I Believe Test (TIB), but recently he has devised the Conceptual Systems Test (CST) which is an objective measure. For Schroder and his associates there is the semiprojective Paragraph Completion Test (PCT) and an Impression Formation Test (IFT). Hunt (1963) has developed a sentence completion test for his work with adolescents while Driver and Streufert (1967) now have a test known as the Purdue-Rutgers Prior Experience Inventory. What aspects of complexity most

of these tests are measuring is still unknown. They could be largely content loaded or perhaps directed towards one or more of the following aspects of structural complexity, namely, differentiation, discrimination, and integration.

To date only two studies (Gardiner, 1968; Vannoy, 1965) have included a large number of so called complexity measures in a factor analysis. In a study of the generality of cognitive complexity Vannoy (1965) factor analyzed a battery of twenty tests. He extracted eight factors, none of which could be considered a general complexity factor. Factor I accounted for 24.3 per cent of the common variance and Factor VIII for only 6.3 per cent after a Varimax rotation. Schroder's PCT was the only test with a large loading (.45) on the latter factor. The apparent orthogonality between the PCT and other complexity measures according to Vannoy (1965) ". . . may be due to the fact that they are largely measures of what Schroder and Streufert (1962, p. 2) term dimensional complexity (p. 394)." They consider it possible for cognitive structure to be highly dimensionalized, but yet remain poorly integrated. However, inspection of Vannoy's principal axes factor loadings indicates that the PCT would have loaded marginally (.29) on a factor of social complexity (Factor II). Further, if he had not sought simple structure, the first principal axes factor would have had eleven tests of complexity load on it (beyond .30) rather than only four (Varimax solution), and would have accounted for 34.4 per cent of the common

variance. Correlations between the PCT and the Kelly Rep Test and Scott's Groups of Nations Test were respectively .05 and .15.

Likewise, Gardiner (1968) performed a factor analysis on a number of accepted complexity measures (PCT, Groups of Nations Test, TIB and ITI) as well as some potential ones. Factor I, which loaded sizeably on all of the accepted complexity tests other than Scott's was identified as a complexity factor. However, after a Varimax rotation it accounted for only 11.3 per cent of the total variance, which is quite similar to Vannoy's finding of 13.2 per cent. Further, the correlations among the PCT, ITI, and TIB ranged from .45 to .61. These two studies indicate considerable lack of agreement among some tests purporting to quantify cognitive complexity and also cast doubt upon the factorial structure of this dimension.

Nonetheless, Schroder and others, (1967) and Crouse, Karlins and Schroder (1968) have persisted in studying integrative complexity. At the level of structural complexity their emphasis is upon the generation of rules or abstract schemata for processing stimulus input. As a measure of integrative complexity they have relied largely upon the PCT. In this test the subject is required to answer each of six sentence stems by writing three sentence responses within ninety seconds. The stems are "Criticism . . . ." "Doubt . . . ." "Rules . . . ." "Criticism means . . . ." "Confusion . . . ."

"Parents . . . ." (Schroder et al., 1967, p. 190). These six items are purported to measure complexity in the interpersonal domain. Scores are given on a 7-point scale. Correlations with intelligence range from .11 to .45 and those with verbal fluency are reported to be negligible (Ibid., p. 197).

The PCT suffers from some obvious difficulties. First, it is a projective device which leads to special scoring problems, for example, personal bias. Scoring it is more time-consuming than scoring an objective measure. Further, the PCT is limited to the social or interpersonal domain and as such can not be expected to assess cognitive structure in non-social areas. The PCT may not be particularly useful with non-college students. Reed (1966) obtained no scores above 4 on the 7-point scale with 189 high school students. He also found the test-retest reliability to be a mere .24 after two weeks while Schroder reports a split-half correlation of only .70 (Schroder et al., 1967, p. 197). For these reasons it was considered desirable to seek another measure of cognitive complexity, particularly an objectively scored one.

As a replacement for the PCT it was decided to use Harvey's CST (Coates, 1968; Harvey, 1966; Harvey et al., 1966, 1968) and a revised form of Tuckman's ITI (1966a; 1966b). The CST consists of forty-nine items which are rated on a 6-point scale from "Completely Disagree" to "Completely Agree." Harvey (1967, p. 211) reports that the same seven factors have turned up on each of the five

revisions of the test. Coates (1968) found that the major factors of the CST remained relatively stable over a period of one year: Divine Fate Control, .89; Need for Structure-Order, .72; and Need for People, .83. Harvey (1969) reports a test-retest reliability (based on a one week interval) of .89. Coates (1968) also found a correlation between the CST and the D- and F-Scales of -.301 and -.531 respectively.

Due to the time needed to complete Tuckman's entire ITI and the fact that an abbreviated ITI was available, it was decided to use the latter test. The short form of the ITI (13 items) was proposed by Gardiner (1968). It included those ITI items which correlated over .20 with his subject's factor scores for his complexity factor. The mean correlation of the 13 items was .248 with a range from .20 to.31. All were significantly different from zero ($N = 109$). Scores on the short form of the ITI were found by the present author to correlate .54 with scores on Tuckman's 36-item ITI which in turn is related to the PCT (contingency coefficient = .54, according to Tuckman, 1966a, p. 378).

While the CST was considered the marker test or chief complexity measure in this study, it was also proposed to examine several other potential measures of cognitive complexity. One test, the abbreviated ITI, has already been mentioned. Other potential measures of complexity included were the RL task as such and a multidimensional scaling technique similar to that used by Driver (1962) and Blackman

and Schroder (1964).

Since it was predicted that the RL task would differentiate between individuals high and low in cognitive complexity, it was also expected that the RL task would serve as a valuable index of integrative complexity and rule formation. Support for such an expectation comes from a study by Torcivia and Laughlin (1968) in which they found an attribute identification task sensitive to group differences in dogmatism. Dogmatism is negatively related to cognitive complexity (Harvey, 1966). Further, support for the above prediction comes from Felknor and Harvey (1964) who found superior concept attainment on a Bruner-type task in their most abstract subjects.

A second approach to the measurement of integration level might be through a form of multidimensional scaling (MDS). In fact, Schroder et al., (1967) state that MDS appears to offer the best approach to assessing rules and integration level. They cite Driver's (1962) research which employed a MDS technique as part of an inter-nation simulation study. Driver had his subjects rate all pairs of nations as to their similarity and then applied the Tucker-Messick individual differences model to the resulting score matrix. He found that the number of dimensions used was related to the Situational Interpretation Test (an objective complexity measure) and that more even weightings among the dimensions were associated with higher complexity. Further, Driver showed that more complex subjects used more

internally generated dimensions as compared to externally given dimensions.

On the basis of Driver's findings it was purposed to apply a MDS technique to a test similar to Driver's. This test--the Similarities Among Nations Test (SANT)--requires the respondent to rate all pairs of ten different nations on a 7-point scale according to their basic similarity. Then the correlations among the nations are obtained for each subject by using the values assigned each nation-pair. Following this the eigenvalues for the correlational matrix are determined and the variance among the five largest calculated. Since each eigenvalue is an indication of the weight given to that dimension, a subject giving fairly even weightings to all dimensions has a small variance among the eigenvalues. Thus, complex individuals have small eigenvalue variances while concrete individuals have large variances. The number of dimensions with eigenvalues greater than one also serves as a measure of complexity.

Correlates of Complexity

Scott (1963) observed that studies of the correlates of cognitive complexity would be valuable in helping to define what this construct is and is not. Harvey (1966, pp. 48-53) has followed this suggestion in an attempt to provide construct validity for his classification of subjects into four systems on the basis of the TIB test. He found that individuals in System 1 scored highest on the F-Scale, followed by Systems 3, 2, and 4, in that order;

that System 1 was highest on Rokeach's opinionation right measure and System 2 highest on his opinionation left measure. Further, Harvey found a negative relationship between a scale of rigidity, anomie, identification with the American motif, church going and cognitive simplicity as measured by Kelly's Role Rep Test. Harvey mentioned an unpublished study by Davis (1964) who found System 2 subjects highest in machiavellianism; System 3 and System 1 highest in need for affiliation; and System 1 subjects highest on self-control, honesty, loyalty, and the like. Mention of these and other correlates of complexity can be found in Coates (1968) and Harvey (1966). Thus, in an attempt to help clarify the scope of the cognitive complexity construct this study investigated a number of other potential correlates of complexity.

Internal-external control. In a review of the literature Lefcourt (1966) defines internal control as "...the perception of positive and/or negative events as being a consequence of one's own actions and thereby under personal control . . ." (Lefcourt, 1966, p. 207), while external control refers to ". . . the perception of positive and/or negative events as being unrelated to one's own behaviors in certain situations and therefore beyond personal control" (p. 207). This construct is measured by Rotter's (1966) Internal-External (I-E) Scale which, Rotter contends, deals with a person's beliefs about the nature of the world. Research on the personality correlates of this dimension

indicates that high external subjects yield significantly more in the Asch situation (Crowne and Liverant, 1963); show less tendency to regulate their behavior to cope with objective probabilities (Liverant and Schodel, 1960); and that external males feel an authority figure is controlling their mastery of the environment (Hamisher, Geller and Rotter, 1968). Other studies suggest that internals are significantly more likely than externals to engage in behaviors that will confront a problem directly (Davis and Phares, 1967; Phares, 1968) and that they will resort to forgetting failures which they attribute to themselves (Efran, 1963).

Now, with increasing levels of integrative complexity, a person's "self" is supposed to become a causal agent in generating new approaches for information processing (Schroder _et al._, 1968, p. 22). If this is the case, a positive relationship between internality and complexity is to be expected. (The actual correlation coefficient will be negative because of the way these tests are scored.)

Religious orientation. Allport and Ross (1967) utilize an extrinsic-versus-intrinsic dimension of religious motivation in an attempt to explain the finding that churchgoers and non-churchgoers do not differ significantly in racial prejudice. On their Religious Orientation Scale (ROS), they found that intrinsic or deeply religious people were less prejudiced than extrinsic or superficially religious people. In the words of Allport's earlier (1958)

book on prejudice, ". . . those who were considered the most devout, more personally absorbed in their religion, were far less prejudiced than the others. The institutional type of attachment, external and political in nature, turns out to be associated with prejudice"(Ibid., p. 421). In addition to intrinsic and extrinsic types, they also identified a group of churchgoers who agreed with any item which favoured religion. This group they called "indiscriminately proreligious." As a group they were more prejudiced than the other religious subgroups and were characterized by an "undifferentiated disposition, dogmatism" and "excessive category width" (Allport and Ross, 1967, p. 442). They also suggested an "indiscriminately anti-religious" subgroup which would disagree with all items tending to favor religion.

Considering the above information, the following relationships would be expected between cognitive complexity and types of religious motivation. There should be a significantly positive relationship between abstractness and an intrinsically religious orientation, but a significantly negative relationship between abstractness and extrinsicness. Moreover, most intrinsic subjects should be found in System 3 and most extrinsic subjects in System 1. Further, anti-religious individuals will be System 2 and 4 subjects--System 2, because they oppose authority and System 4, because they do not depend on external guidance or support. Finally, most indiscriminately pro-religious individuals

will be in System 1.

Impulsivity. In their research in the area of response sets, Couch and Keniston (1960) developed a twenty-item scale known as the Agreement Response Scale (ARS), which on the basis of their factor analysis is perhaps more appropriately considered a measure of impulsivity. Using this measure, they identified two groups of individuals, "yeasayers" and "naysayers." The "yeasayers" were described as admitting stimuli to consciousness without censorship, and by agreeing with, acting out and otherwise yielding to the pressures of input. "Naysayers" were characterized by opposite kinds of information processing and interpersonal behavior. They tended to be stable and reflective individuals somewhat akin to the reflective pole of Kagan's (1965) reflection-impulsivity dimension. According to the above description, "yeasayers" may be expected to resemble simple-concrete individuals while the "naysayers" are complex-abstract. Thus a negative relationship is expected between a high score on the ARS (yeasaying) and cognitive complexity.

Conceptual models of behavior. Shaw (1968) discussed three models by which people's beliefs and attitudes towards behavior can be conceptualized. They are the theological, illness, and psychological (scientific) models. Those who adhere to the theological model perceive maladaptive behavior to be the result of sin and change due to divine

intervention. Adherents to the illness model accept a psychodynamic outlook while the followers of the psychological model tend to prefer a learning explanation of maladaptive behavior. Shaw constructed a test--the Beliefs-About-Behavior Inventory (BABI)--which he found useful in discriminating among adherents to the various models (for example, clergy versus computing science students). Test-retest reliability was reported at .70 after five weeks. He also found low but significant correlations between the ITI, using continuous scoring, and the three BABI scales: .233 with the Theological Scale, .123 with the Illness Scale, and .164 with the Psychological Scale ($N = 319$). All were in the predicted direction. This study hoped to replicate the relationships found between complexity level and the utilization of the psychological, illness, and theological models. Complex individuals are expected to reject the appeal to the external authority of the theological model for the more analytic and less rigid psychological one.

<u>Jungian typologies</u>. Several predictions will be made concerning the complexity dimension and the Myers-Briggs Type Indicator (MBTI). The MBTI is a self report instrument based on a Jungian typology (Myers, 1962) which classifies people into dichotomous categories along each of four interlocking dimensions. These include extraversion-introversion (E-I), sensation-intuition (S-N), thinking-feeling (T-F) and judging-perceiving (J-P). Stricker and

Ross (1962) write that ". . . extraversion-introversion indicates the focus of cognitive activity, judging-perceiving describes its predominant nature, and the four functions involve its specific varieties" (p. 2).

According to Myers (1962) the introvert is chiefly interested in concepts and ideas while the extrovert is concerned with the outer world of people and things. Therefore, the introvert likes to direct perception and judgment upon ideas, while the extrovert likes to direct both upon his outside environment. Similarly, the cognitively complex individual probably prefers the world of concepts and ideas. Thus, a positive relationship is predicted between the E-I scale and complexity level.

The J-P scale was designed to discriminate between the attitude of judging which demands that incoming information be shut off so that a judgment can be made, and the perceiving attitude where one does not judge but awaits the arrival of new information. Since cognitively complex subjects spend more time processing information (Karlins et al., 1967) the J-P scale should relate positively with cognitive complexity. However, it should be noted that a factor analysis by Ross (1963) does not clearly support Myer's expectation for this scale. Rather it is sensitive to planfulness and orderliness.

Ross (1963) writes that the S-N scale appears to deal with the ". . . information processing characteristics of the subject" (p. 16). Sensation is associated with a

preference for the common-sense and practicality while intuition ". . . enriches stimulus information, adds unconscious information and possibilities suggested by the stimulus" (p. 16). In his factor analysis, Ross found intuition to load on an ability factor. Thus, since the complex individual is supposed to draw upon internal resources for generating new ways for processing information, there should be a positive relationship between complexity and the S-N scale.

Myers (1962) has stated that the T-F scale is designed to determine if a person emphasizes the rational over the sentimental approach to life. While Ross (1963) did not support this interpretation, he found that the thinking types were more interested in business and work. Thus, assuming that the abstract person tends to be analytic, a negative relationship is predicted between the T-F scale and complexity level.

The previous discussion may be summarized by predicting that complex individuals will be INTP types and that cognitively simple individuals will be ESFJ types.

CHAPTER IV

METHOD

There were two phases to the data collection. The first included the administration of the tests of complexity and its hypothesized correlates. The other phase involved carrying out a rule learning experiment which the author programmed on the IBM 1500 system.

Testing

The tests listed in Table II were administered in two parts to the students in an introductory educational psychology course. In September of 1968, the complexity measures (Harvey's Conceptual Systems Test, a short form of the Interpersonal Topical Inventory and the Similarities Among Nations Test) together with the BABI and Rotter's I-E Scale were administered to the introductory class of 550 students. All five measures were satisfactorily completed by 468 students. The second part of the testing was carried out during November by the students' seminar leaders. At this time the MBTI, ROS, and ARS were completed. Only 396 students were tested at this time of which 300 completed all three measures. The smaller sample resulted from the fact that not all seminar leaders participated fully, some forgot to take all three tests to class and some students were absent. Further, scores on

TABLE II

NUMBER OF SUBJECTS COMPLETING EACH TEST

Test	N
1. Harvey's Conceptual Systems Test	539
2. Short Interpersonal Topical Inventory	525
3. Similarities Among Nations Test	519
4. Rotter's Internal-External Scale	531
5. Beliefs-About-Behavior Inventory	523
6. Agreement Response Scale	344
7. Religious Orientation Scale	323
8. Myers-Briggs Type Indicator	396

the Verbal and Numerical parts of the Co-operative Academic Ability Test (CAAT) were available from the Student Counselling Service for only 358 students. In summary, 564 students completed some tests (321 females and 243 males) but only 236 students (137 females and 99 males) completed all tests. However, when the CAAT was included only 137 students (87 females and 50 males) had complete test scores.

Scoring

CST. Information obtained from Harvey was used to score the CST (see Appendix A-1). Each of the 49 items received a score from 1 for "Completely Disagree" to 6 for "Completely Agree." Items 42 and 44 were scored in the reverse direction. Means were obtained for the six subtests and the subjects were classified into the four systems (or none at all) on the basis of certain profile means. (See Appendix A-2 for the classification criteria.) Scoring was done by a Fortran program.

A method of continuous scoring was suggested by CST data reported in Coates (1968). This method used a linear combination of the subtests which correlated highest with an abstractness measure (Harvey's This I Believe Test). Thus, the means of Divine Fate Control; Need for Structure-Order; and General Pessimism subtests which correlated--.463, - .264, and - .322 respectively with abstractness were summed. Another continuous score was simply the summed means of the six subtests. High subtest scores indicate low complexity. These last two scoring methods did not allow

subjects to be classified into the four systems as Harvey does.

Similarities among nations. Each of the forty-five pairs of nations received a score from 1 for "Extremely Similar" to 7 for "Extremely Dissimilar." These forty-five scores for each subject were punched on cards and a computer program was used to form a 10 x 10 matrix with zeros in the diagonal for perfect similarity, that is, a nation with itself. Next, the Fortran program obtained the inter-correlations among profiles of nations which was taken as a measure of internation similarity. Then the 10 eigenvalues were found by the Jacobi method. The subject's score was the variance among the five largest eigenvalues. A high variance was taken to indicate low complexity.

A second score for the SANT was the number of eigenvalues greater than or equal to one. This resulted in many ties (range was 2-4). The larger the number, the greater is the complexity.

A copy of the SANT may be found in Appendix A-3.

Interpersonal topical inventory. The short 13-item version of the ITI (see Appendix A-4) was scored by counting the number of times the subject chose the more complex alternative of each pair of alternatives. Scores could thus range from 0 to 13. Using data available from another study (N = 36), this method was found to correlate .54 with actual system classifications (based

on the complete ITI). The scoring system is described in Appendix A-5.

Other tests. Scoring of the Internal-External Scale followed Rotter's (1966) directions. One point was given for each external answer. Thus, a high score represented external control. The slightly shortened version used in this study (17 items instead of 23) is shown in Appendix A-6.

The Agreement Response Scale (ARS) was scored according to Couch and Keniston (1960). Each item was rated on a 7-point scale and the total of the 19 items was obtained. High scores were associated with "yea saying."

A copy of the ARS is shown in Appendix A-7.

Shaw's (1968) instructions were followed in scoring the BABI (see Appendix A-8 and Appendix A-9). The three scales are ipsative and provide a total score of 120.

The ROS was scored after the instructions of Allport and Ross (1967). A high score on the Intrinsic Scale suggests extrinsicness as does a high score on the Extrinsic Scale. On the other hand, a highly intrinsic person would make a numerically low score on the Intrinsic Scale. An extrinsic type of person would score above the median of both tests while an intrinsic type would fall below the median. Subjects were also classified as indiscriminately pro-religious if their Intrinsic score was 12

or more points less than their Extrinsic score. If their score was 12 or more points greater, they were classified as indiscriminately anti-religious. A copy of this test is shown in Appendix A-10. The scoring procedure is given in Appendix A-11.

The Myers-Briggs Type Indicator was scored using continuous scores as suggested by Myers (1962). For example, an extrovert would score below 100 and an introvert above 100. Further, Intuitive Feeling and Preceiving types would be above loo, while their counterparts, Sensation, Thinking, and Judging would score below 100.

Rule Learning Study

Subjects. Seventy-two subjects completed the RL task and were selected from among those who took the CST. Table III shows the number and percentage of subjects falling into the four systems as well as the total CAAT scores of those used in the rule learning experiment. Eighteen subjects were randomly selected within each system but the small number in System 2 and 4 plus failures and unavoidable losses meant that nearly everyone in those systems was asked to participate. Twenty subjects who failed to reach criterion were replaced. They were equally distributed among the four systems. Another four subjects gave up before solving all the problems and sixteen other subjects were lost because of various problems with the computer or response retrieval. Assignment of subjects to order of rules was random.

TABLE III

CST CLASSIFICATIONS AND
ABILITY SCORES

Systems	Number	Percentage	Ability Mean	S.D
System 1	177	33	65.22[a]	12.41
System 2	31	6	68.89	8.75
System 3	196	36	70.11	9.52
System 4	45	8	75.22	10.47
Unclassifiable	91	17		

[a]N = 18

Scheffe's test for multiple comparisons of means indicated a significant difference between the total CAAT scores of System 1 and System 4 ($p = .036$). There was also a significant difference between System 1 and System 4 on the CAAT Verbal Scale ($p = .006$) but not on the CAAT Numerical Scale.

Stimulus materials. The 81 stimuli that were used by the computer program depicted all possible combinations of four dimensions and their three values. The dimensions and their values were as follows: colour (red, yellow, blue); shape (triangle, square, circle); size (large, medium, small); and number of figures (one, two, three).

These stimuli were shot on specially coded 16 mm film strips for use with the IBM 1512 Image Projector. The frames were randomly placed on the film but with the following restrictions: (1) no more than four positive or negative instances were allowed to appear consecutively; (2) no more than three instances of the same attribute contingency (for example, PP or AP) occurred in a row; (3) within any sequence of sixteen frames the PP contingency appeared at least once, while the other three contingencies appeared at least twice; (4) each attribute pair occurred at least once during the first nine frames; and (5) the first frame for a problem was always a positive instance.

Experimental design. The rule learning experiment was a 4 x 6 x 3 x 3 factorial study with the last two factors repeated. The first factor was the four conceptual systems; the second, the six possible orders for presenting the three conceptual rules; the third factor, the three rules (inclusive disjunction, joint denial, and biconditional); and the last factor, the three problems (red and triangle, one figure and yellow, and large and blue). The dependent variables were trials to criterion, errors to criterion, total time in seconds to criterion, and mean time for each response. In addition, the proportion of PP, PA, AP, and AA errors were obtained.

The computer program. The actual experiment was

carried out on the IBM 1500 Instructional System at the University of Alberta. Instructions for the computer were coded in the Coursewriter II language (IBM, 1967) which is designed to present materials to a student, accept and process his responses. Some 5000 instructions (or 80 pages of print out) constituted the software for the course (known as RL123).[2]

When a subject arrived for the experiment he was seated at one of 16 IBM 1510 Instruction Display units (cathode ray tube) equipped with a familiar typewriter keyboard and a light pen. At his left was an IBM 1512 Image projector which allowed random access to 1024 frames. The subject was signed on to the experimental course RL123 by the proctor and given a number from one to six to type in so that his sequence of rules could be determined later. From this point, the subject had only to follow the instructions flashed on the cathode ray tube and respond with the light pen.

After "sign-on" the subject was welcomed, asked to type his full name, and the code number (for order of rules). He was given general instructions to the effect that he would have to learn to classify the frames into groups. Then he was shown five frames along with text describing their important characteristics. Stress was

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[2]A copy of the program can be obtained from the Division of Educational Research Services.

placed on the size dimension. A table describing the stimulus population (frames) was shown. Specific instructions followed:

> By now you should be ready to start. Just remember that for each frame you must determine if it belongs to the POS group or the NEG group. Then just touch the light after POS or NEG. At first you will have to guess, but you will soon learn how the rule works and always be correct. However, to make sure that you understand the rule we will not stop until you are right 16 times in a row. Please take your time. Being right is more important than going fast.
>
> Just a word of caution. You will be given a clue for each problem. For example, you may be told that the two relevant attributes are <u>red</u> and <u>circle</u>. This means that you can solve the problem by only paying attention to the presence and absence of red and circle. Everything else, for example, size and number, will confuse you. Just attend to the two relevant attributes.

After these instructions were given the computer branched the subject to one of the three rules (disjunction, joint denial, and biconditional) depending upon the

number that had been typed in. For example, the number "3" would result in the joint denial first, the disjunction next and the biconditional rule last. Next the computer determined the random order for the three problems, that is, if the first, second, and third pair of relevant attributes for that rule would be red and triangle, one figure and yellow, or large and blue. This was done at the start of each rule. At this juncture, the subject was told:

> Here is a clue for this problem. The two relevant attributes are________ and_______. By paying attention to their presence and absence you will find this problem easy. Go ahead.

Then as each frame appeared he classified it into the POS or NEG class by touching a spot of light beside POS or NEG with the light pen. Feedback as "Right" or "Wrong" was programmed to follow the response by one second. But due to certain processing characteristics of the computer this interval was variable. The frame remained after feedback for 1.5 seconds to allow for inspection. Then the shutter closed and one second later a new frame was displayed. This sequence continued until the subject made 16 correct responses in a row or until he had had 150 opportunities to reach criterion. If the latter occurred, the subject was branched

directly to the last segment of the program, told the purpose of the experiment (if he wished to know) and thanked. On the other hand, a successful problem solver moved through the remaining sequence of rules and problems until all three rules (9 problems) were completed. Once the last problem was solved, the subject was allowed to see tables showing a record of his performance by rule and problem for errors, trials, and time in minutes. He could also see eighty lines of text outlining the purpose of the experiment. He was then thanked and bid farewell. Total execution time varied from 45 to 90 minutes.

During the experiment, response data for each subject was recorded on a performance disc. Later the significant information was summarized in a print-out for each subject. This included the subject's name, order of rules, order of problems for each rule, and the total number of trials, errors, time in tenths of seconds, and mean response time for each of the nine problems. The proportion of PP, PA, AP, and AA errors were obtained for each problem as well as the number of the PP, PA, AP, and AA trial whereon the last error had occurred.

CHAPTER V

RESULTS

Rule Learning and Complexity Level

Four-way analyses of variance were performed on trials, errors, time, and mean response time data. Although, the distribution of scores was skewed and the variances were heterogeneous, a transformation of the data was not considered necessary as Winer (1962, pp. 61-62) has indicated that the analysis of variance is robust with respect to these characteristics provided that the cell sizes are equal.[3] Only the results of the analysis of the error data will be reported here as it is nearly identical to the results for trials, time and mean response time (see Appendix B for these tables). The only differences were that there was a significant problems x order interaction for trials and an insignificant rules x problems interaction for mean response time. The error means and standard deviations by order of rules, type of rule, and problems are shown in Table IV. In Table V the analysis of variance for errors is summarized.

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[3]Analyses of variance were carried out later on the data after a square root transformation had been performed but the results were similar to those reported on the raw scores.

TABLE IV

ERROR MEANS AND STANDARD DEVIATIONS BY ORDER FOR RULES AND PROBLEMS

	Order 1[a]		Order 2		Order 3		Order 4		Order 5		Order 6	
Rule	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Inclusive Disjunction												
Problem 1	4.00[b]	3.74	3.08	1.93	1.08	1.16	3.17	2.21	1.75	1.66	3.25	6.38
Problem 2	1.33	2.31	0.92	1.38	0.83	1.53	0.83	1.03	0.33	0.49	1.00	2.59
Problem 3	1.50	3.15	1.00	2.00	0.08	0.29	0.58	0.67	0.42	0.51	0.33	1.15
Joint Denial												
Problem 1	2.33	2.19	2.08	1.16	10.25	10.50	16.08	13.30	2.50	2.54	2.92	2.11
Problem 2	0.50	0.80	1.08	1.62	2.17	2.69	2.67	5.90	0.33	0.65	0.42	0.67
Problem 3	0.58	0.90	0.25	0.45	0.25	0.45	1.50	2.54	0.08	0.29	0.58	1.44
Biconditional												
Problem 1	10.67	11.29	11.08	13.72	7.00	7.75	7.92	7.72	12.17	10.77	20.33	18.82
Problem 2	1.50	1.93	1.00	1.13	1.67	3.26	1.50	1.45	1.58	2.07	7.83	14.27
Problem 3	1.00	2.00	2.83	5.31	0.58	1.00	3.00	8.23	1.08	1.08	0.67	0.78

[a] If the inclusive disjunction is given number 1, joint denial number 2 and biconditional number 3, the six orders are respectively 123, 132, 213, 231, 312, and 321. Thus, order 6 is biconditional-joint denial and disjunction.

[b] N for each mean is 12.

TABLE V

ANALYSIS OF VARIANCE FOR ERROR DATA

Source	df	MS	F	P
Complexity level (A)	3	19.45	.392	NS
Order of rules (B)	5	77.64	1.565	NS
A x B	15	32.76	.660	NS
Error	48	49.60		
Rules (C)	2	805.62	20.259	<.0001
A x C	6	22.09	.556	NS
B x C	10	162.85	4.095	<.0001
A x B x C	30	31.20	.785	NS
Error	96	39.77		
Problems (D)	2	2231.90	84.505	<.0001
A x D	6	4.82	.183	NS
B x D	10	31.87	1.207	NS
A x B x D	30	32.05	1.214	NS
Error	96	26.41		
C x D	4	347.16	12.312	<.0001
A x C x D	12	34.98	1.241	NS
B x C x D	20	85.37	3.027	<.0001
A x B x C x D	60	24.54	.871	NS
Error	192	28.20		

The main effects for conceptual level as measured by the CST and for order of rules were not statistically significant. However, there were highly significant effects for both rules and problems. Figure 1 depicts the improvement in rule learning over the three problems. Newman-Keuls tests (Winer, 1962, p. 309ff) indicated that on problem 1 significantly more errors were made on the biconditional rule than either the joint denial or disjunctive rule ($p < .01$). The latter two rules differed significantly at the .05 level. One-tailed correlated t tests indicated that the biconditional rule was significantly more difficult than the disjunctive rule on problems 2 and 3 ($p < .05$) and more difficult than the joint denial on problem 3 ($p < .05$). A Newman-Keuls test for problems indicated that more errors were committed on problem 1 than either problem 2 or 3 ($p < .01$) which did not differ significantly from one another. Finally, there was a statistically significant rules x problems interaction. Figure 1 suggests that this was largely due to the transfer from problem 1, where differences among rules were large, to problems 2 and 3 where these differences were insignificant. Thus, those factors responsible for errors on problem 1 were not effective on later problems.

In addition to these findings, there were significant interactions between order of solution and type of rule, and a three-way interaction for order, rules, and

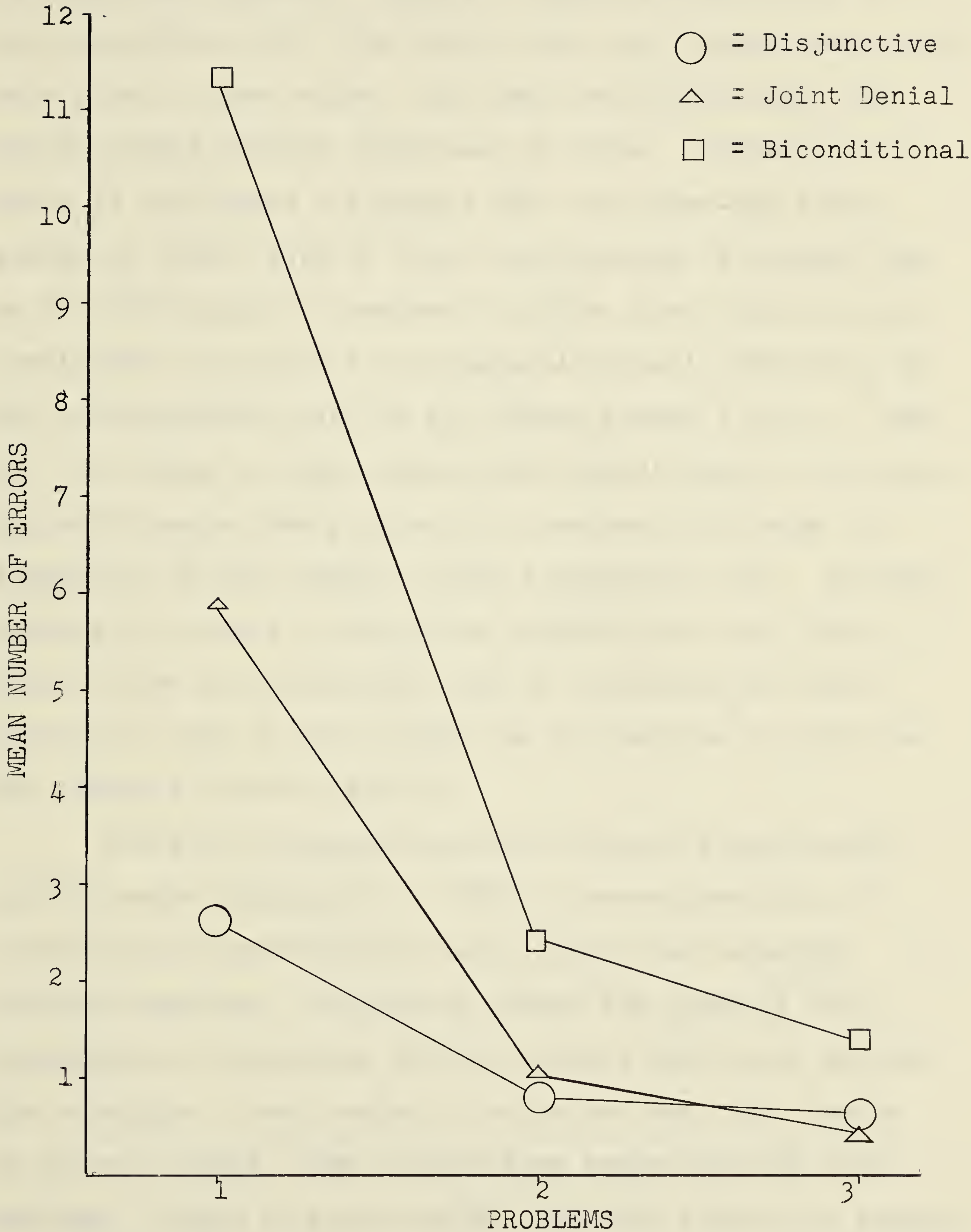

Figure 1. Mean number of errors for rules and problems. N=72 for each data point.

problems. These results require that the rule main effect be qualified somewhat. Figure 2 suggests that except for the disjunctive rule, the other rules were hardest when they were first in the series, but that the biconditional was nearly always hardest regardless of order. Inspection of Table IV and Figure 2 suggests that the three-way interaction of order, type of rule, and problems is largely due to the difficulty of problem 1 for the joint denial and biconditional rules and to the general overall difficulty of the biconditional rule for all orders except 3 and 4. That is, the change in joint denial and biconditional rule learning performance from problem 1 to problem 2 is large in comparison to the change for the disjunctive rule. Further, whereas the orders in which the biconditional and joint denial rules are presented first in the series are most difficult, this is not so when the disjunction is first in the sequence (order 1 and 2).

Since the complexity groups differed significantly in CAAT verbal ability ($p = .006$) a two-way analysis of covariance was performed on each of the four dependent variable measures. Complexity groups and order of rule presentation represented the two factors and verbal ability the covariate. Each subject's score was the total number of errors, trials, time or mean time needed for the nine problems. Under no condition was the main effect for groups significant. However, there was a significant effect for order of rules with the trial data ($F = 2.41$, $df = 5, 47$,

Figure 2. Mean number of errors for each rule for the six orders. N = 12 for each data point.

$p = .05$). For errors and time data the order effect only approached significance with p equal to .09 and .11 respectively. Mean response time was unaffected. Inspection of the means for the six orders indicated that order 4 and 6 were most difficult. Order 4 was joint denial followed by biconditional and then disjunction while order 6 saw the biconditional rule followed by joint denial with disjunction last. In all of the other orders, disjunction was either the first or second rule in the sequence. This finding suggests that the easy disjunctive rule served to facilitate transfer to other more difficult rules. Finally, in the covariance analysis, none of the interactions between complexity and order of rules were statistically significant.

Since it was hypothesized that rules would be differentially sensitive to group complexity differences, two-way (groups by order) analyses of covariance were conducted separately for the three rules on each dependent variable measure. Verbal ability served as the covariate and the rule learning score (criterion) was represented by the total score for the three problems using that rule. However, since the criterion and covariate turned out to be unrelated, the covariance analysis provided essentially the same results as the analysis of variance. For this reason only the results of the analysis of variance will be reported. The differences among order of rule solutions for the error data can be obtained by summing over problems in Table IV.

Appendix B may be consulted for order of solution differences for trial, time and mean response time data.

In the case of the disjunctive rule, there were no statistically significant effects with the trial and error data for groups, order of rules or their interaction. However, there was a significant order effect for time to solution ($F = 8.01$, $df = 5, 48$, $p < .001$). Appendix B-3 shows that order 1 and 2 are the most difficult. In addition, the analysis on mean response time (disjunctive rule) indicated that both main effects and their interaction yielded statistically significant results. The means for the groups are plotted in Figure 3. An analysis of variance for these results is summarized in Table VI.

For the joint denial rule, one or more main effects were significant for each dependent variable measure. In the analysis for errors, both main effects and their interaction were statistically significant (see Table VI). Figure 4 shows that System 3 and 4 made fewer errors on order 3 than the other systems and that System 3 also had little difficulty with order 4. Thus, the groups x order interaction seems to be due to the fact that System 3 and 4 did not find the joint denial rule difficult when it was given first.

For the trial data, the order effect held up ($F = 12.66$, $df=5, 48$, $p < .001$) as well as the interaction between complexity level and order ($F = 2.89$, $df = 15, 48$, $p = .003$).

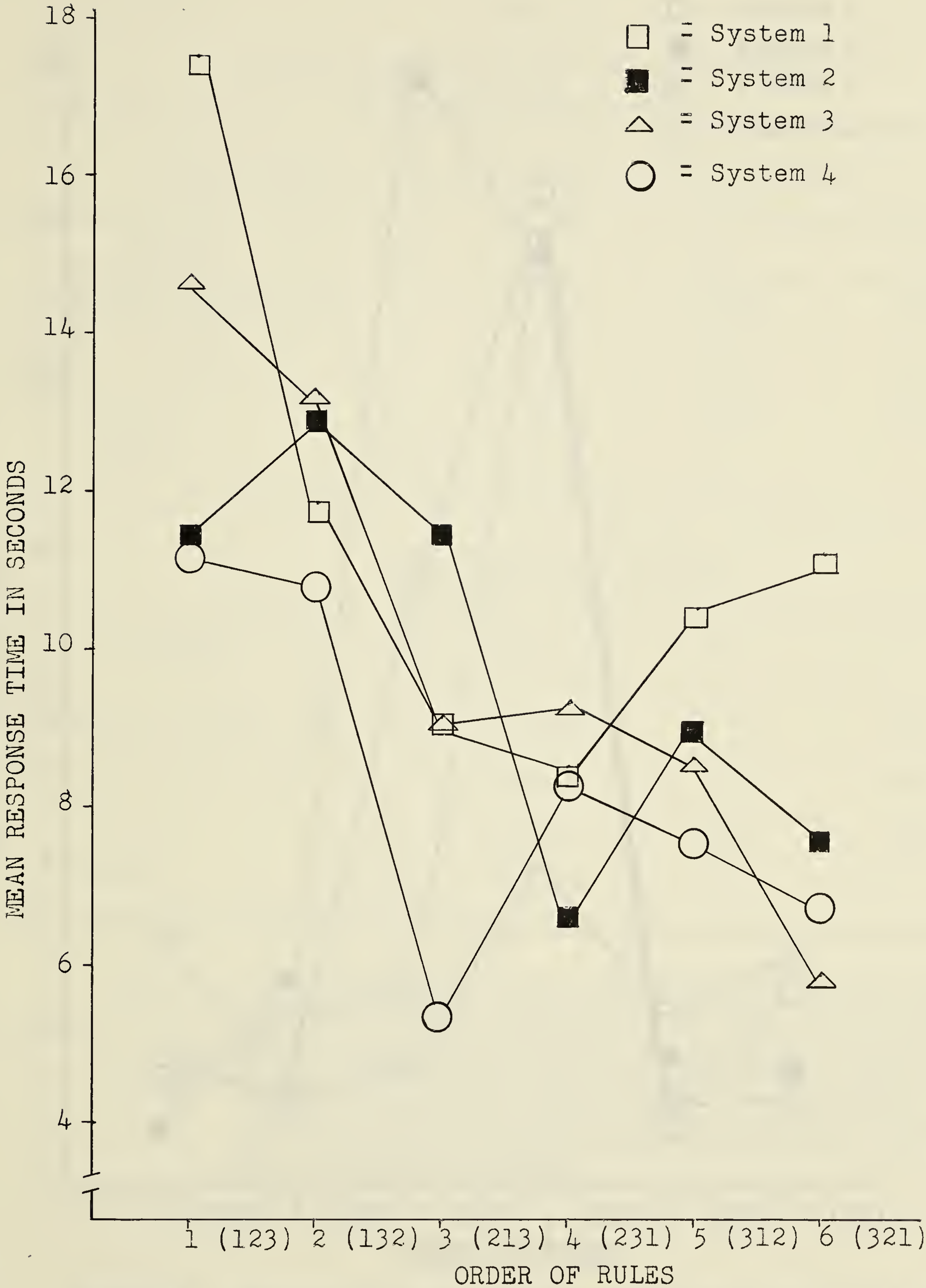

Figure 3. Mean response time on disjunctive rule (sum of 3 problems) for each group by order of rule solution. Order 1 and 2 have disjunction first. N = 3.

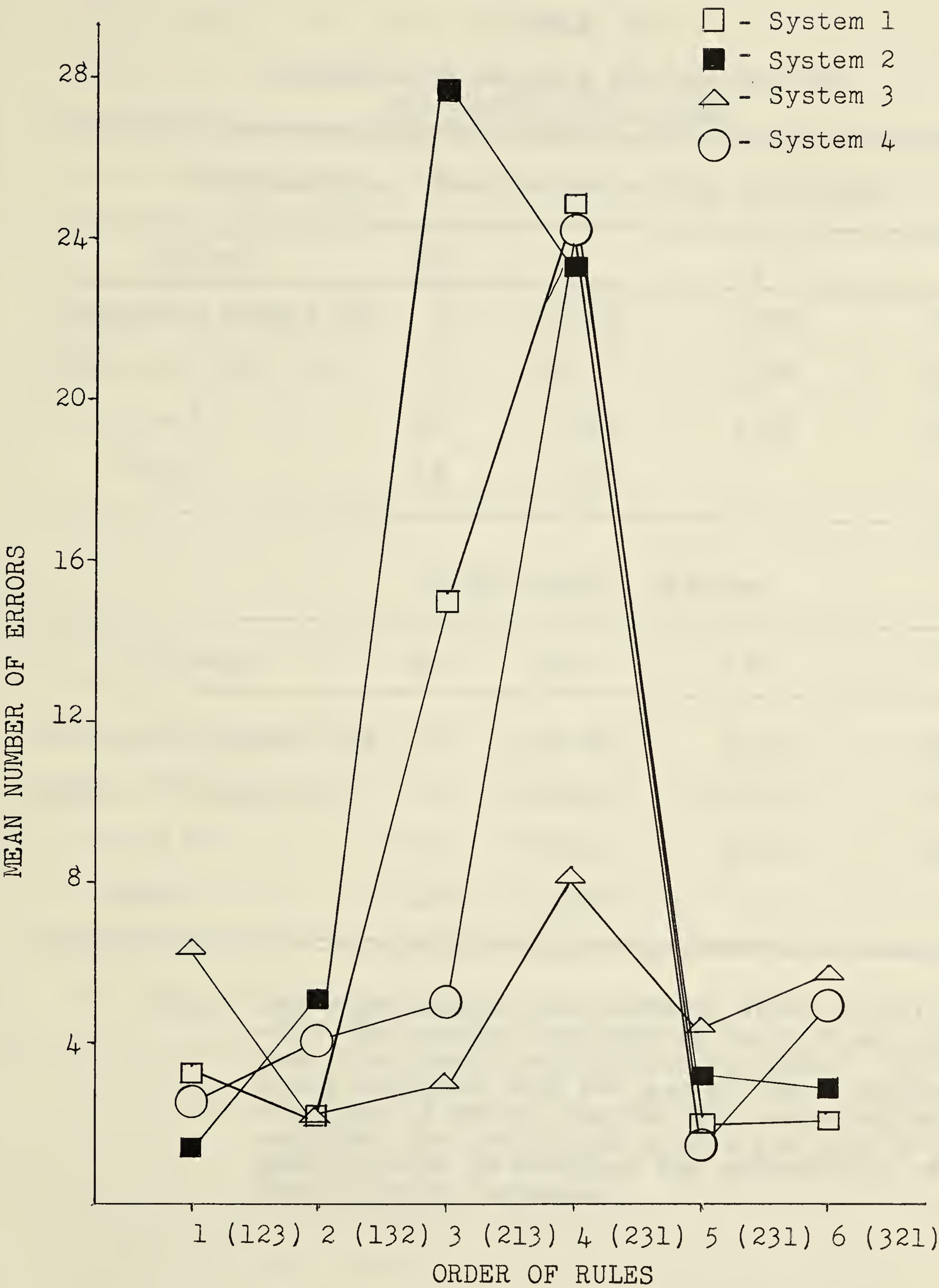

Figure 4. Mean errors on joint denial rule (sum of 3 problems) for each group by order of rule solution. Order 3 and 4 have joint denial first. N = 3.

TABLE VI

ANALYSES OF VARIANCE FOR DISJUNCTIVE AND JOINT DENIAL RULES

Disjunction: Mean Response Time in Seconds

Source	df	MS	F	P
Complexity groups (A)	3	27.16	5.87	.002
Order of rules (B)	5	69.37	14.98	.000
A x B	15	9.02	1.95	.041
Error	48	4.63		

Joint Denial: Errors

Source	df	MS	F	P
Complexity groups (A)	3	101.69	2.91	.044
Order of rules (B)	5	620.49	17.75	.000
A x B	15	103.19	2.95	.002
Error	48	34.96		

Note: The significant group effects above do not agree with the results reported in Table V and Appendix B-6. Two facts may account for this: (1) the above analyses used the sum of the 3 problems as a subject's score, whereas the 4-way ANOVAs employed the individual scores for each problem, and (2) with 12 analyses the probability of a Type I error increases.

This suggests that the first rule to be learned is the most difficult but the interaction indicates that this is not the case for all complexity groups, namely, Systems 3 and 4 (see Appendix B-1). The order effect for total time was statistically significant ($F = 9.67$, $df = 5, 48$, $p < .001$). Likewise, the order effect for mean response time ($F = 3.46$, $df = 5, 48$, $p = .010$) was statistically significant.

With the biconditional rule, the order effect for total time solution was significant ($F = 2.58$. $df = 5, 48$, $p = .038$). The mean response time for order was also significant ($F = 2.77$, $df = 5, 48$, $p = .028$). Both of these results, however, are largely due to the difficulty of the biconditional-joint denial-disjunctive sequence (order 6).

<u>Errors by attribute contingency</u>. It was hypothesized that the complexity groups might behave differently in learning to classify the four attribute pairs correctly for the different rules. For example, System 1 subjects might be expected to have more difficulty placing the AA instance into the positive category for the biconditional rule than would System 4 subjects. To examine such a possibility, one-way analyses of variance were carried out for the groups for each contingency for each rule. Only the results of problem 1 will be reported here as too few errors occurred on problem 2 and problem 3 to yield reliable results.

Table VII depicts the proportion of errors for each attribute contingency by rule and conceptual system. The

TABLE VII

PROPORTION OF ERRORS FOR ATTRIBUTE CONTINGENCIES FOR PROBLEM 1 BY RULE AND GROUP (N = 18)

Rule		System 1	System 2	System 3	System 4
Inclusive	PP[a]	.36	.25	.26	.13
Disjunction	PA	.29	.37	.18	.32
	AP	.09	.06	.12	.22
	AA	.20[b]	.14	.22	.18
Joint	PP	.42	.36	.46	.42
Denial	PA	.19	.17	.20	.25
	AP	.11	.13	.11	.07
	AA	.22	.27	.22	.27
Biconditional	PP	.24	.25	.25	.20
	PA	.11	.22	.23	.17
	AP	.13	.09	.13	.09
	AA	.51	.43	.40	.53

[a]Attribute contingencies.

[b]Totals are < 1.00 as some subjects made no errors.

complexity groups did not differ in their ability to cope with the PP instance in the case of the joint denial rule or with the AA instance with the biconditional rule. However, the four groups differed in their proportion of errors for the PA instance with the biconditional rule ($F = 2.87$, $df = 3, 64$, $p = .043$) while the AP instance of the disjunctive rule approached significance ($p = .076$). In view of the number of analyses run (12) and their marginal significance, these results should only be considered as suggestive of group differences for this variable.

One-way analyses of variance were carried out on problem 1 to see if particular types of errors were peculiar to individual rules. A summary of these analyses is presented in Table VIII. In all cases the differences among contingencies were highly significant. With the disjunctive rule, a Newman-Keuls test indicated that more errors occurred on the PP and PA contingencies than on the AP contingency ($p < .05$). The PP and PA contingencies did not differ significantly from the AA contingency or from each other.

Differences were clearer on the joint denial and biconditional rules. With the joint denial rule, encoding the PP contingency was significantly more difficult ($p < .01$) than any of the other contingencies. The AA contingency was more difficult than the AP contingency ($p < .05$) which on all rules seems to create the least difficulty. In the case of the biconditional rule,

TABLE VIII

ANALYSES OF VARIANCE FOR ATTRIBUTE CONTINGENCIES FOR EACH RULE

Inclusive Disjunctive Rule

Source	df	MS	F	P
Between people	67	.0365		
Within people	204	.1040		
Contingencies	3	.3460	3.445	.0177
Residual (error)	201	.1004		
Total	271			

Joint Denial Rule

Source	df	MS	F	P
Between people	67	.0072		
Within people	204	.1146		
Contingencies	3	1.1416	11.4974	<.0001
Residual (error)	201	.0993		
Total	271			

Biconditional Rule

Source	df	MS	F	P
Between people	67	.00002		
Within people	204	.0730		
Contingencies	3	1.6431	33.1240	<.0001
Residual (error)	201	.0496		
Total	271			

encoding the AA instance was significantly more difficult than any of the other contingencies ($p < .01$). Further, the PP instance caused more difficulty than the AP contingency ($p < .01$) while the AP and PA contingencies did not differ significantly from one another.

Revised classifications. Since the CST, ITI, and SANT were practically orthogonal to each other, it was decided to categorize the subjects on the basis of each of them. This made it possible to see if rule learning performance was related to one of these measures of complexity. Subjects scoring greater than and less than 8 on the short ITI were placed into a high and low complexity group, respectively. Subjects were also divided at the median for the SANT. Three-way analyses of variance for groups, rules, and problems were conducted on the error data. In neither case were there significant differences between the high and low groups. Rules and problems differed significantly as in the four-way analysis of variance.

RL non-solvers. Records were available for 17 subjects who failed to reach criterion in 150 trials. Fourteen failed to solve the first problem, one the third problem and and two the fourth problem--which represented the start of the biconditional rule. The difficulty of the biconditional rule is clearly indicated by the fact that 13 subjects failed it; three the joint denial; and one the disjunction.

Moreover, it was the AA contingency which gave the most difficulty on the biconditional rule. The average proportions for the PP, PA, AP, and AA instances were respectively .10, .26, .21, and .42. One-tailed t tests indicated that the AA contingency was significantly more difficult than any of the other instances ($p < .05$) and that the PA and AP were more difficult than the PP ($p < .01$) but not from each other. Thus, the rule learning performance of the non-solvers does not appear to be qualitatively different from that of successful rule learners.

Measures of Complexity

Short ITI. Gardiner's (1968) shortened ITI was expected to prove useful as a measure of cognitive complexity. In Table IX the intercorrelations between the ITI, CST, SANT and other hypothesized complexity correlates are shown. Clearly the short form of the ITI, which was found by the present author to correlate .54 with the actual system classifications on a sample of nurses ($N = 36$), is unrelated to the CST, SANT and most other predicted correlates of complexity. Stewin (1969) also found the CST and ITI classifications totally unrelated ($r = -0.000$).

SANT. Inspection of the correlation matrix (Table IX) shows that both the variance score and the number of significant dimensions (eigenvalues greater than one) are unrelated to the CST and the predicted correlates of complexity.

TABLE IX

CORRELATIONS AMONG COMPLEXITY TESTS AND THEIR CORRELATES

	Test	1[a]	2	3	4	5	6	7	8
1.	Harvey's CST	1000[b]	087	-012	-039	-068	-246	122	128
2.	Short ITI	087	1000	197	-181	-128	-173	135	141
3.	SANT (variance)	-012	197	1000	735	-042	152	-101	-020
4.	SANT (dimensions)	-039	-181	-735	1000	051	-008	008	-021
5.	Rotter's I-E Scale	-068	-128	-042	051	1000	017	-094	105
6.	BABI Theological	-246	-173	152	-008	017	1000	-613	-318
7.	BABI Illness	122	135	-101	008	-094	-613	1000	-537
8.	BABI Psychological	128	041	-020	-021	105	-318	-537	1000
9.	Agreement Response	260	-031	-025	-007	348	-116	002	131
10.	CAAT Verbal	138	146	053	-148	-155	-236	217	-015
11.	CAAT Numerical	109	136	172	-132	-087	-080	039	064
12.	CAAT Total	155	172	125	-173	-149	-196	162	023
13.	ROS Intrinsic	566	014	019	004	157	-229	-004	227
14.	ROS Extrinsic	031	-179	-006	013	098	193	-252	117
15.	MBTI E-I Scale	-140	040	090	-021	-006	118	-092	-029
16.	MBTI S-N Scale	065	038	-180	074	-029	-228	271	-076
17.	MBTI T-F Scale	-023	-101	-230	075	-033	093	019	-098
18.	MBTI J-P Scale	364	028	-118	-012	113	-326	107	209

[a]N = 137

[b]All decimals are three places from the right.

TABLE IX (continued)

	9	10	11	12	13	14	15	16	17	18
1.	260	138	109	155	566	031	-140	065	-023	364
2.	-031	146	136	172	014	-179	040	038	-101	028
3.	-025	053	172	125	019	-006	090	-180	-230	-118
4.	-007	-148	-132	-173	004	013	-021	074	075	-012
5.	348	-155	-087	-149	157	-098	-006	-029	-033	113
6.	-116	-236	-080	-196	-229	193	118	-228	093	-326
7.	002	217	039	162	-004	-252	-092	271	019	107
8.	131	-015	064	023	227	117	-029	-076	-098	209
9.	1000	013	-022	-003	380	034	-266	202	162	347
10.	013	1000	437	869	-059	-154	-047	343	030	192
11.	-022	437	1000	818	114	-105	147	246	-034	174
12.	-003	869	818	1000	032	-152	044	345	005	212
13.	380	-059	114	032	1000	124	-119	026	-081	396
14.	034	-154	-105	-152	124	1000	-035	-229	-008	015
15.	-266	-047	147	044	-119	-035	1000	-119	-124	002
16.	202	343	246	345	026	-229	-119	1000	269	402
17.	162	030	-034	005	-081	-008	-124	269	1000	167
18.	347	192	174	212	396	015	002	402	167	1000

Driver (1962) has shown that subjects low in complexity use more external referents in their perception of nations than those high in complexity. He found the latter group to use more internally-generated dimensions (less situation bound). Consequently, an attempt was made to interpret the dimensions employed by small groups (N = 5) of extreme SANT scores. The sample was randomly drawn from those subjects with eigenvalue variances less than one (N = 21) and greater than ten (N = 21). Average ratings for each group were obtained, correlated, and then factor analyzed.

Tables X and XI show the first four principal axes factors for the high and low complex subjects respectively (as measured by the SANT). The simple subjects tend to weight the first dimension heavily on political freedom (dictatorship versus democracy), and the second dimension appears to be one of relative militancy. The complex individuals use other dimensions. Factor I appears to contrast corporate capitalism with bureaucratic communism; Factor II appears to be an international militancy dimension; Factor III loads on development of natural resources; but the fourth dimension does not appear to be interpretable. Thus, although concrete individuals in contrast to complex individuals appear to view nations almost entirely in terms of a political freedom dimension (62 per cent versus 26 per cent of total variance), it is not clear if the two groups can be said to differ in terms of internally or externally

TABLE X

PRINCIPAL AXES FACTORS FOR HIGH COMPLEXITY SUBJECTS

Tests (Nations)	Factor I	Factor II	Factor III	Factor IV	Communalities
Australia	.660	.442	.253	.076	.700
Brazil	.506	.068	.503	-.143	.534
Cuba	-.779	.297	.283	.178	.807
Egypt	.126	.449	.568	.421	.718
France	-.126	.454	-.399	.545	.678
India	.171	-.864	.321	-.072	.884
Red China	-.751	-.057	.267	-.177	.670
Sweden	.150	-.426	-.612	.529	.847
U.S.A.	.654	.350	-.419	-.427	.909
Russia	-.482	.351	-.341	-.583	.812
Column Sum of Squares	2.596	1.864	1.716	1.367	7.543
Per cent of Common Variance	34.329	24.773	22.762	18.137	100.000
Per cent of Total Variance	25.945	18.723	17.203	13.707	75.430

TABLE XI

PRINCIPAL AXES FACTORS FOR
LOW COMPLEXITY SUBJECTS

Tests (Nations)	Factor I	Factor II	Factor III	Factor IV	Communities
Australia	.960	.018	.118	.110	.948
Brazil	-.219	.803	.489	-.220	.980
Cuba	-.945	-.129	-.044	.183	.945
Egypt	-.819	.391	.051	.217	.873
France	-.201	.943	-.088	.037	.939
India	.842	.160	.250	.381	.942
Red China	-.946	-.144	.035	-.104	.928
Sweden	.480	.534	-.675	-.030	.972
U.S.A.	.930	-.136	.071	-.221	.937
Russia	-.972	-.154	-.054	-.002	.971
Column Sum of Squares	6.228	2.058	.790	.345	9.421
Per cent of Common Variance	65.893	22.018	8.400	3.690	100.000
Per cent of Total Variance	62.177	20.776	7.926	3.482	94.210

generated dimensions.

Similar results were found with another sample of individuals from the population mentioned above.

RL task. The analysis of variance showed that the complexity groups were not significantly different on any of the rule learning measures. Thus, in terms of cognitive complexity as measured by the CST, the RL task does not appear to have any value as a complexity test. Also, since the rules themselves are only slightly related to one another, no consistent correlations between rule and complexity correlates are to be expected. Appendix B-8 shows some intercorrelations among rules for the four measures. Moreover, the heterogeneous nature of the rules was noted in a factor analysis (not described here) where 10 factors were extracted using the criterion of eigenvalues greater than one.

Correlates of Complexity

The significance of the correlates of complexity was assessed in three ways: (1) by analysis of variance; (2) by the use of factor analysis; and (3) by tests of the significance of the correlations. Additional information on the correlates may be found in Appendix B-7.

Analysis of variance. One-way analyses of variance were conducted for 17 variables on a sample of subjects drawn randomly from the systems other than 2 and 4 which only had a small number of subjects in them. Table XII

TABLE XII

MEANS AND SAMPLE SIZES OF CORRELATES USED
IN ANALYSES OF VARIANCE

Correlate	System 1		System 2		System 3		System 4	
	N	Mean	N	Mean	N	Mean	N	Mean
1. I-E Scale	37	6.84	30	8.33	40	5.73	40	7.25
2. Theological Scale	39	37.92	31	32.87	40	34.70	38	33.61
3. Illness Scale	39	35.00	31	36.00	40	37.05	38	39.13
4. Psychological Scale	24	47.08	28	52.07	22	47.91	25	48.24
5. Agreement Response Scale	17	74.18	25	82.20	22	80.27	24	81.38
6. ROS Intrinsic	19	25.53	21	36.33	19	33.00	24	35.42
7. ROS Extrinsic	19	30.84	21	28.67	19	27.95	24	28.46
8. MBTI E-I Scale	25	104.12	28	103.79	22	97.82	27	116.04
9. MBTI S-N Scale	25	97.96	28	92.93	22	95.55	27	103.07
10. MBTI T-F Scale	24	117.25	28	99.07	22	108.09	25	101.72
11. MBTI J-P Scale	25	100.28	28	117.64	22	112.09	27	128.93
12. CAAT Verbal	24	30.29	23	32.48	21	34.10	23	33.35
13. CAAT Numerical	24	35.58	23	36.91	21	36.62	23	37.48
14. CAAT Total	24	65.89	23	69.30	21	70.71	23	70.91
15. ITI	39	7.67	30	6.87	39	8.28	38	7.81
16. SANT (variance)	38	4.80	31	4.06	37	4.70	36	3.71
17. SANT (dimensions)	38	2.71	31	3.03	37	2.76	36	2.97

presents the means and sample sizes for the four systems on the 17 variables. The F ratios and significance levels are presented in Table XIII.

There were statistically significant differences among the four systems on six of the variables and marginally significant differences ($<.10$) on three more. Variables on which significant differences occurred included the following: I-E Scale, BABI Theological Scale, ROS Intrinsic Scale, the MBTI T-F and J-P Scales, and the ITI (short form). The three marginally significant variables were the BABI Illness and Psychological Scales and the MBTI E-I Scale. Using the Newman-Keuls test, the following differences were found among the systems. System 2 was more external (I-E Scale) than any other group ($p<.05$). On the Theological Scale, System 1 scored significantly higher than the other systems ($p<.05$). System 1 was the most intrinsic group on the ROS ($p<.05$). On the T-F Scale, System 1 was significantly more feeling or tender-minded than System 2 ($p<.05$). In the case of the J-P Scale, System 1 preferred judgment and System 4 preferred to await more information. This was significant beyond the .05 level. Finally, the ITI mean for System 2 was significantly lower than the means for System 3, 4, and 1, in that order ($p<.05$), but the latter systems did not differ significantly from each other. The means are depicted in Table XII.

<u>Factor analysis</u>. A principal axes factor analysis

TABLE XIII

ANALYSIS OF VARIANCE ON CORRELATES FOR CST GROUPS

Correlate	df	F	P
1. Rotter's I-E Scale	3, 143	6.32	.0005
2. Theological Scale	3, 144	3.90	.01
3. Illness Scale	3, 144	2.29	.08
4. Psychological Scale	3, 95	2.16	.10
5. Agreement Response Scale	3, 84	1.47	.23
6. ROS Intrinsic	3, 79	14.34	.000002
7. ROS Extrinsic	3, 79	0.62	.60
8. MBTI E-I Scale	3, 98	2.21	.09
9. MBTI S-N Scale	3, 98	0.59	.63
10. MBTI T-F Scale	3, 95	3.05	.03
11. MBTI J-P Scale	3, 98	4.79	.004
12. CAAT Verbal	3, 87	1.54	.21
13. CAAT Numerical	3, 87	0.47	.71
14. CAAT Total	3, 87	1.33	.27
15. ITI	3, 142	4.45	.005
16. SANT (Variance)	3, 138	1.57	.20
17. SANT (Dimensions)	3, 138	1.81	.15

was performed on the battery of tests administered to the introductory education students. While eight factors had eigenvalues greater than one, only the first four factors were interpreted. Table XIV shows the four unrotated factors, their communalities and the variance accounted for by each. Factor I which accounts for 36.19 per cent of the common variance is described as a "conceptual systems" factor since it loads on Harvey's CST and its predicted correlates. If the CST is used as the marker test then individuals high in complexity tend not to rely upon God and/or other external sources of guidance (DFC, Theological, and ROS Intrinsic Scales), tolerate ambiguity and disorder (NS-O), operate on a scientific view of behavior (Psychological Scale), tend to postpone judgment (J-P Scale), and rely more on intuition than sensation (S-N Scale). Further, individuals high in cognitive complexity do not have a strong need for helping people (NHP), tend to be open to new stimulation (ARS) and are relatively intellectual (CAAT).

Factor II appears to be a factor of sociability. The positive loadings are on need to help people (NHP), need for people (NFP), intuition (S-N), feeling or tender-mindedness (T-F), verbal ability and a weak loading on the ITI. Negative factor loadings indicate interpersonal aggression (IA), general pessimism (GP), introversion (E-I) and internal control (I-E).

TABLE XIV

PRINCIPAL AXES FACTOR ANALYSIS FOR THE CORRELATES OF COGNITIVE COMPLEXITY

Test[a]	I	II	III	IV	Communalities
1. DFC	-807[b]	-021	041	-184	687
2. NS-O	-618	033	-108	294	481
3. NHP	-368	572	-117	274	551
4. NFP	-144	402	-492	424	604
5. IA	284	-541	-012	-104	384
6. GP	047	-654	-106	095	450
7. CST	669	126	-031	292	550
8. ITI	056	215	442	167	273
9. SANT - v	-092	-079	610	612	761
10. SANT - d	005	-078	-602	-530	649
11. I-E (Rotter)	211	-387	-304	053	290
12. Theological	-491	-228	-066	039	299
13. Psychological	379	-194	-043	170	212
14. ARS	484	143	-393	288	492
15. Verbal	271	413	385	-113	405
16. Numerical	303	124	496	-101	363
17. ROS Intrinsic	739	-224	-139	283	696
18. ROS Extrinsic	-087	-283	-278	281	244
19. E-I	-074	-391	459	-411	538
20. S-N	355	542	005	-358	548
21. T-F	-013	456	-299	-248	359
22. J-P	728	143	009	-209	594
Column sums of Squares	3.775	2.536	2.255	1.864	10.430
Per cent of Common Variance	36.19	24.31	21.62	17.87	100.00
Per cent of Total Variance	17.16	11.53	10.25	8.47	47.41

[a]Consult Appendix B-7 for complete names of the tests.

[b]All decimals are dropped.

Factor III is tentatively labelled a factor of intellectual complexity. Positive contributions are from ITI, the ability tests and introversion. Negative loadings are on need for people (NFP), the SANT, internal control (I-E), naysaying (ARS), task application (T-F)and extrinsicness (ROS-Extrinsic).

Factor IV may be tentatively called a factor of behavioral conformity. This is suggested by the loadings on need for people, need for security and order, need to help people, the SANT (reflecting a simple political outlook), agreement response (ARS), extraversion (E-I) and a reliance on the senses (S-N). Factor loadings which suggest more individualistic behavior are those for the CST, I-E Scale (internality) and religious extrinsicness.

Correlations. Table X V shows the Pearson product moment correlations between the hypothesized correlates and the CST. The number of subjects, means, standard deviationsand the probability the $p = 0.0$ are included. The BABI Theological and Illness scales are related to complexity level as predicted. Likewise, the S-N Scale and J-P Scale are positively correlated with complexity. Ability has a low but significant correlation with complexity level as Schroder et al., (1967) has reported. The ARS, E-I, and ROS Intrinsic scales were significantly correlated with the CST but in the opposite direction from that predicted. The I-E Scale, Psychological Scale, ROS extrinsic and T-F Scale were unrelated to complexity level as measured by the CST.

TABLE XV

CORRELATIONS BETWEEN CST AND SOME CORRELATES

Correlate	N	Mean	S.D.	r	P	PD[a]
I-E Scale	522	6.87	2.87	-.043	.331	-
BABI Theological	515	35.02	6.86	-.139	.002	-
BABI Illness	515	37.38	7.45	.083	.061	+
BABI Psychological	515	47.67	6.94	.045	.304	+
ARS	326	78.25	13.45	.212	.000	-
ROS Intrinsic	306	29.10	8.78	.239	.000	-
ROS Extrinsic	306	30.10	6.62	-.053	.359	-
E-I Scale	376	99.11	26.19	-.144	.005	+
S-N Scale	376	94.66	28.13	.167	.001	+
T-F Scale	376	108.11	21.54	.003	.960	-
J-P Scale	376	104.97	29.42	.218	.000	+
CAAT Verbal	346	31.25	6.70	.112	.036	+
CAAT Numerical	346	35.52	5.79	.115	.033	+
CAAT Total	346	66.75	10.38	.140	.009	+

[a]Predicted direction of correlation (+ or -).

Types of Religious Orientation

Several hypotheses were formulated concerning the conceptual system with which individuals with differing religious orientations would be associated. Table XVI shows the proportion of subjects of different religious orientations (intrinsic, extrinsic, pro and anti-religious) which fall into the four systems on the CST. Chi squares between religious orientation by System 1, 2, 3, and 4 were respectively 41.4, 18.68, 9.51, and 6.19. All but the last chi square was significant at the .05 level (df = 3), suggesting that religious orientation is not equally distributed within conceptual systems. Tests of chi square were also conducted across systems for each of the categories of religious motivation. The null hypothesis that these categories would be distributed equally across conceptual systems was tested. The resulting chi squares for the intrinsic, extrinsic, IPR and IAR categories were respectively 46.00, 13.11, 54.78, and 5.21 of which all but the last one was significant beyond the .01 level (df = 3). Thus, the conceptual systems differ in their most preferred religious orientations. Inspection of the partitioned chi square in Table XVI indicates that most intrinsically religious individuals were in System 1 and the least in System 2 and 4; that most extrinsically religious subjects were in System 3; and that by far the most IPR individuals belonged

TABLE XVI

NUMBER AND PROPORTION OF SUBJECTS IN CONCEPTUAL SYSTEMS OF DIFFERENT RELIGIOUS ORIENTATIONS

Group	Unclassifiable	Intrinsic	Extrinsic	IPR[a]	IAR[b]
			Religious Orientation		
System 1	.21[c] (16)	.36 (27)	.05 (4)	.37(28)	.01(1)
	8.78[d]	32.24	2.58	38.01	2.96
System 2	.05 (1)	.05 (1)	.53 (10)	.00 (0)	.37 (7)
	5.88	7.61	.18	9.25	1.07
System 3	.23 (11)	.17 (8)	.35.(17)	.17 (8)	.08 (4)
	1.36	.24	7.78	.17	.12
System 4	.18 (3)	.12 (2)	.25 (4)	.06 (1)	.41 (7)
	2.91	5.92	2.58	7.36	1.07

[a]Indiscriminately pro-religious.

[b]Indiscriminately anti-religious.

[c]Proportions within systems.

[d]Partitioned chi square across systems.

to system 1. Table XVI suggests that the IAR individuals come from System 2 and 4. Thus, except for the finding that intrinsicness was negatively related to complexity rather than positively related, these results were consistent with the hypotheses.

CHAPTER VI

DISCUSSION

Rule Learning and Cognitive Complexity

The major purpose of this study was to test Schroder's assumption that integrative complexity is characterized by the ability to generate and utilize a wide variety of rules. Although he did not clarify the precise nature of these rules, it was argued that an experiment employing rules from symbolic logic would be a valid test of Schroder's assumption. The results of the experiment, however, failed to find any strong relationship between rule learning and complexity level as measured by the CST: only in two instances did the groups differ in rule learning. Thus, the null hypothesis that individuals high in integrative complexity are not superior to less complex individuals in rule learning tasks cannot be clearly rejected.

There are several explanations which might account for the very limited support obtained for Schroder's position. One possibility is that the CST and PCT do not measure the same aspects of complexity. The evidence is generally indirect. Stewin (1969) has found the CST to be totally unrelated to the ITI which is reported to have a reasonably high correlation to the PCT (Gardiner, 1968; Tuckman, 1966a). The present study also obtained a

negligible correlation (.08) between a short form of the ITI and the CST. Similarly, the only evidence in support of a CST and PCT relationship is indirect. Gardiner (1968) obtained a significant correlation of .691 between the TIB and the PCT--the parent of the CST. Harvey et al., (1966, 1968) found both the CST and TIB useful in discriminating between the teaching performance of individuals high and low in cognitive complexity. Finally, Coates (1968) reports a moderate but significant correlation of .339 between the CST and a continuous scoring approach to the TIB (N = 65). Thus, in view of the uncertainty about the relationship of the CST and PCT, Schroder's assumption can not be considered completely invalid; merely implausible.

A second reason why Schroder's position in regard to integrative complexity may still be correct is that the rule learning task may not be an appropriate test of rule formation and utilization in Schroder's sense. The rules used in the present study were nominal rules taken from symbolic logic. They may not correspond adequately to the rules of conditionality, comparing, and relating that Schroder writes about (Schroder et al., 1967, pp. 18-23) although they do appear to correspond to his rules of categorizing (Ibid., p. 15). However, even at the level of categorization, the rule learning task could be considered inappropriate as a test of Schroder's assumption

since the PCT which he employs as a measure of integrative complexity is apparently limited to the social domain (Crouse et al., 1968, p. 645). If the latter is the case, then Schroder's position must be tested by rules relevant to social situations, (perhaps along the line of Rigney, Bieri, and Tripodi, 1964), unless it can be demonstrated that the PCT measures a factor of general complexity.

In summary, Schroder's assumption concerning integrative complexity and rule formation and utilization can not be considered invalidated until more about the relationship of the CST and PCT is known and until more is known about rules relevant to social situations. The present results may only be considered as a basis for a tentative questioning of Schroder's assumption, particularly in view of the two cases of group differences in learning disjunctive and joint denial rules.

Findings Concerning Rule Learning

The results of the present experiment supported and in a small way extended the findings in the rule learning literature. They confirm the order of difficulty among conceptual rules for untrained subjects as found by Haygood and Bourne (1965). The data clearly indicate that for naive subjects the inclusive disjunction, joint denial and biconditional rules differ significantly in difficulty on problem 1 and further that the biconditional is still more difficult on problem 2 and

problem 3. Problem 1 solution for the disjunctive, joint denial, and biconditional took 23.2, 32.8, and 46.1 trials respectively. Thus, even when the relevant attributes are given, there are wide differences in rule difficulty--a conclusion which could not be drawn from the complete learning (CL) experiments of Hunt and Kreuter (1962), Neisser and Weene (1962) and Hunt, Marin, and Stone (1966).

These differences in difficulty were associated with the peculiar manner in which attribute contingencies were assigned to response categories under each rule. Since subjects prefer working with positive instances (Bourne and Guy, 1968b; Fryatt and Tulving, 1963; Hovland and Weiss, 1953; Wason, 1963) the disjunctive rule as might be expected was the easiest. Instances depicting one or more of the relevant attributes had to go into the positive category while the AA instance belonged in the negative category. But, in the case of the joint denial and biconditional unusual demands were made. For the joint denial, the AA was positive and for the biconditional rule both the AA and PP instances belonged in the positive category. Consequently, it was not surprising to find that the PP instance was most difficult in the case of the joint denial and the AA instance for the biconditional rule. Previous studies (Bourne and Guy, 1968a; Bower and King; 1967; King, 1966) have found the AA instance most difficult for the biconditional. However, no study has

previously reported the source of joint denial difficulty.

Rule differences tend to be transient. With practice, subjects became very efficient with the disjunction, joint denial, and biconditional rules so that on the last two problems, the error rate approached zero for all rules. In fact, on problem 3, no errors were committed on the disjunction, joint denial, and biconditional rules by 12, 16, and 12 subjects respectively, from the 24 subjects receiving these rules first. The degree of intrarule transfer (improvement over problems) is consistent with other rule learning studies (Bourne and Guy, 1968a; Bower and King, 1967; Haygood and Bourne, 1965). Interrule transfer is not nearly so great, although the marginally significant order effect obtained in this study does suggest that under certain conditions subsequent performance on different rules may be facilitated. In this study, having the easier disjunctive rule early in the sequence appeared to help the subject's performance on the more difficult rules. Bourne and Guy (1968a) also noted facilitative effects: they found biconditional rule learning to improve directly with the number of rules learned (1 - 3 rules) and when the subjects were only trained on one rule, the conditional (most difficult) was the best one.

Both intrarule and interrule transfer appear to result from the acquisition of a scheme for encoding the stimulus population. Bourne (1967) has suggested that a

sort of truth table mediator is learnt in a rule learning task. If this is so, then any rule learning problem becomes an almost trivial paired-associate task. This device or scheme would explain why few significant differences are found on problems 2 and 3. It also implies that any problem based on a new or strange rule should require only a few trials to learn--at least for the initiated rule learner: untrained subjects often attend to irrelevant attributes on problem 1 (Bower and King, 1967).

Measures of Cognitive Complexity

Three plausible measures of cognitive complexity were investigated in this study, but all failed to correlate significantly with the marker test (CST). The SANT was even unrelated to the hypothesized correlates of complexity. Only a few variables (Interpersonal Aggression subtest, Theological Scale, extrinsicness, CAAT and SANT scores) correlated significantly with the short ITI. Further, the RL task was found to be very heterogeneous (there were negligible correlations among rules) and hence was not consistently related to any of the predicted correlates.

How can these inconsistencies be accounted for? First, it is possible that none of these tests is a valid measure of the construct, cognitive complexity. Against this possibility is Tuckman's (1966a; 1966b) finding that the ITI, which is related to the short form used here,

obtains results consistent with PCT classifications and with the expectations of an interpersonal probing study. Moreover, the SANT is based upon the research of Driver (1962) which showed that complex individuals used more dimensions and weighed them more evenly than less complex individuals. The reports of Blackman and Schroder (1964) and Schroder and Blackman (1965) also indicate the value of multidimensional scaling for understanding cognitive structure. On the other hand, evidence for the utility of the RL task as a measure of integrative complexity is more tenuous. Support came indirectly from the studies of Felknor and Harvey (1964) and Torcivia and Laughlin (1968) in the area of attribute identification. Thus, it does not appear reasonable to conclude that none of these tests may measure cognitive complexity. Further, until we have more precise information about the nature of the cognitive complexity dimension, no test can properly be considered as the most valid measure.

Finally, it seems quite possible to maintain that all of these tests (at least the ITI and SANT) are measuring some aspect of complexity, albeit different ones. This leads to the viewpoint that cognitive complexity is not a general factor, but domain specific--a point for which there is considerable evidence. Vannoy (1965, for instance, obtained eight factors from a factor analysis of twenty complexity tests. Schroder

et al., (1967) states that " . . . structural characteristics in an individual may vary across different stimulus areas--from interpersonal to political to mathematical stimuli, for example" (p. 185). They also discuss tests for three aspects of cognitive complexity; namely, differentation, discrimination, and integration (Ibid., Appendix 1). Signell (1966) found differences in the cognitive structures for the perception of people and nations. Further, Gardner and Schoen (1962) stated that no single principle would be likely to account for the complexity-simplicity construct. In other words, as has been found, the short ITI, SANT and even the CST are probably measuring different aspects of cognitive complexity.

Some comments on the value and apparent composition of the complexity measures tested here are in order. The short ITI, although consisting of items with only moderate correlations with a somewhat weak complexity factor, may have value as an index of intellectual complexity. A principal axes factor analysis of 22 tests (see Table XIV) found the ITI to load marginally (.442) on Factor III which was identified as intellectual complexity. Thus, the short ITI may have some value when time is limited, but the complete ITI with its added classification provision is to be preferred.

Table IX shows that the SANT was not highly correlated with any other test. There were low, but significant

negative correlations with the short ITI and the three ability scores. Yet this measure seemed to have a good theoretical basis in the work of Driver (1962), Helm and Tucker (1962), Jackson and Messick (1963), Robinson and Hefner (1967) and Tucker and Messick (1963). The latter authors showed that in perceiving political leaders, Republicans used fewer dimensions than Democrats. Similarly, Robinson and Hefner (1967) found that in rating nations, college professors placed most emphasis on an economic development dimension, whereas a public sample put a communism-democracy dimension foremost. Such findings suggest that the multidimensional approach used in the SANT should differentiate among concrete and abstract individuals. Indeed, the factor analyses carried out for extreme scores on the SANT offered some validity for this expectation. The unidimensional individual (concrete) saw the nations as either democracies or dictatorships, whereas the abstract person (on the SANT) weighted their political dimension much more lightly and utilized other factors in their perception as well.

Of the three measures, The RL task is probably the least useful as a complexity measure. Besides being unrelated to the complexity correlates, it has little internal consistency. Appendix B-8 shows that there was a negligible correlation among rules. Again, the first problem was not significantly correlated with the

two following ones. Probably, different cognitive abilities are required to learn the different rules.

Correlates of Complexity

The results of this study indicated that the CST classifications differed significantly on a number of the predicted correlates. The results of the analyses of variance were generally consistent with Harvey's (1966, 1967) discussions of cognitive complexity. First, the finding that System 1 subjects adhered significantly more to the theological model, were more intrinsic and tender-minded (T-F scale) than were members of System 2, is in agreement with the descriptions of these individuals offered by Harvey (1966). Naturally, as System 2 subjects are largely characterized by pessimism and antisocial attitudes, these results are not unexpected. A significantly higher external score for System 2 individuals than for System 3 subjects indicates that the former tend to perceive events as beyond their control (Rotter and Mulry, 1965). In accordance with Rotter's (1966) interpretation, System 3 individuals see themselves as controlling external events and hence reinforcements. Again, the finding that System 4 subjects in comparison to System 1 subjects preferred perceiving to judging (J-P scale) is congruent with the results of Sieber and Lanzetta (1964) and Stager (1967). These authors found that highly complex subjects took

significantly more predecision time than individuals low in cognitive complexity. This presumably reflects a tendency on the part of more complex individuals to consider and/or generate more alternative solutions to a problem. Finally, the low score of System 2 individuals on the short ITI probably stems from their anti-social characteristics and the fact that the ITI has a strong social content.

The factor analysis (Table XIV) also tended to support Harvey's (1966) descriptions of the personality and beliefs of individuals varying in cognitive complexity. Factor I was identified as a conceptual systems factor since the CST and most of its predicted correlates loaded on it. The high positive loading on the ARS was opposite to expectations and as such raises some questions about this measure. Perhaps, it is a test of stimulus acceptance or openness to input versus stimulus rejection rather than a test of impulsivity. As such it would be more congruent with complexity theory as the complex person must be open to new information, never closed minded or dogmatic (Harvey, 1966). The positive loading on the ROS Intrinsic Scale (meaning low intrinsicness) was contrary to expectation. This may mean that highly complex individuals find religion to be irrelevant to their lives or it could be an artifact of the fact that the CST places religious individuals into System 1, a practice which might be questioned.

<u>Some Implications for Complexity Theory</u>

The results of this study suggest that the construct of cognitive complexity is not as general a trait as has sometimes been implied in the literature. The low intercorrelations among the tests of complexity and the results of the factor analysis (Table XIV) tend to support a domain specific concept of cognitive complexity. This position agrees with the conclusions of researchers such as Scott (1963), Schroder *et al*., (1967), and Vannoy (1965). Vannoy (1965) wrote that ". . . tests of cognitive complexity may . . . attest, simply to one aspect of a more general characteristic of human thought usually referred to as concept formation" (p. 395). Reed (1966) found that PCT performance could be predicted from several ability measures.

Some consideration needs to be given to the instruments used to measure cognitive complexity. If, as it has been suggested, this construct is a rather specific one, then tests should be developed or identified as measures of specific cognitive domains, perhaps along the line of French, Ekstrom, and Price (1963). This implies that future researchers interested in social behavior and cognitive complexity should use measures such as the ITI and PCT. Someone interested in non-social behavior or perhaps dimensionality of concepts might select the Sant or Scott's Groups of Nations Test. Above all, it

appears that much more research is needed to identify the personality and/or cognitive domains being tapped by the so-called measures of cognitive complexity. Finally, more information is needed on the reliability of many complexity tests before meaningful results can be obtained.

CHAPTER VII

SUMMARY

The present investigation was undertaken for three main purposes: (1) to examine the validity of Schroder's position that more integratively complex individuals utilize more complex rules for processing information (stimulus inputs) than cognitively simple individuals; (2) to examine the value of the short ITI, a multidimensional scaling technique and the RL task as measures of cognitive complexity; and (3) to identify more of the correlates of cognitive complexity.

Schroder's position was tested by having eighteen members of the four conceptual systems learn three rules (inclusive disjunction, joint denial, and biconditional) each with three problems. Criterion for solution was sixteen correct responses in a row. Data on the number of trials taken, number of errors made, time needed and mean response time for each trial was recorded. The entire experiment was conducted on the IBM 1500 instructional system at the University of Alberta, Edmonton. Subjects were classified into the four systems on the basis of their CST scores.

The results of this experiment failed to show any overall significant differences among the four systems

on the four dependent variable measures. However, when scores for each problem within the three rules were summed and an analysis was performed on each rule, groups differed significantly on two occasions. In the case of the joint denial rule, the more complex subjects made fewer errors than the less complex ones and for the disjunctive rule, complex individuals took less time in responding than their more concrete counterparts. The latter finding was opposite to that predicted. The results were interpreted as supporting a tentative questioning of Schroder's position.

The significant results for rules and for problems confirmed earlier findings in the rule learning literature and also showed that the novelty of a computer-directed experiment does not eliminate differences among rules. Rules differed in difficulty in the following order, from hardest to easiest, biconditional, joint denial and inclusive disjunction. The differences were discussed in terms of the peculiar demands made by each rule for assignment to the positive and negative response categories. The significant improvement in performance from problem 1 to problem 2 was considered in terms of an encoding scheme reminiscent of the truth table as well as partly the result of learning not to attend to irrelevant dimensions.

In regard to the value of three potential measures

of cognitive complexity, little positive support was found. The RL task turned out to be too heterogeneous in that the rules were unrelated to each other and hence inconsistent correlations were found with the CST and complexity correlates. The short form of the ITI was not significantly correlated with the CST or in general with its correlates. Finally, the SANT was unrelated to the CST and its correlates and negatively related to the ITI. The above findings were taken to mean that they measured different aspects of cognitive complexity which is probably more domain specific than has been implied in the literature.

As for the third purpose of this study, analyses of variance showed that groups formed on the basis of the CST differed on a number of the hypothesized correlates. For instance, Systems 1 and 2 subjects were significantly different on adherence to the theological model, intrinsic religious motivation, and tender-mindedness, System 4 in contrast to System 1 preferred perception to judgment (J-P scale) and System 2 were lowest on social complexity as measured by the ITI. These findings at least help to delineate what the CST is measuring but provide little clarification for the SANT and ITI.

In the discussion, the question of the generality of the complexity construct was raised. It was concluded that complexity is probably domain specific.

Hence, it was pointed out that future research must determine what domains present complexity measures are actually measuring as well as assessing their reliability. Thus, it seems reasonable to conclude that before any meaningful findings are to be obtained from cognitive complexity research, significantly more consideration must be given to the problems of measurement and definition.

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A P P E N D I C E S

APPENDIX A

APPENDIX	A-1	A Copy of the CST
APPENDIX	A-2	Scoring the CST
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NAME ____________________________

Please indicate the extent to which you agree or disagree with each of the following statements by marking an "X" in the appropriate place on the 6 point scale. There is no time limit. Have you any questions?

	STRONGLY DISAGREE	DISAGREE	SLIGHTLY DISAGREE	SLIGHTLY AGREE	AGREE	STRONGLY AGREE
1. I believe that to attain my goals it is only necessary for me to live as God would have me live						
2. I like to have a place for everything and everything in its place						
3. Any written work that I do I like to have precise, neat, and well organized						
4. I like my friends to confide in me and to tell me their troubles						
5. I like to join clubs or social groups						
6. I like to make as many friends as I can						
7. I feel like telling other people off when I disagree with them						
8. These days a person doesn't really know whom he can count on						
9. In the final analysis events in the world will ultimately be in line with the master plan of God						
10. I like to keep my things neat and orderly on my deak and workspace						
11. I don't like for things to be uncertain and unpredictable						
12. I always like for other people to tell me their problems						
13. I enjoy very much being a part of a group						
14. I like to form new friendships						
15. I feel like getting revenge when someone has insulted me						
16. You sometimes can't help wondering whether anything's worthwile anymore						

	STRONGLY DISAGREE	DISAGREE	SLIGHTLY DISAGREE	SLIGHTLY AGREE	AGREE	STRONGLY AGREE
17. The way to peace in the world is through religion						
18. I like to have my work organized and planned before beginning it						
19. I find that a well-organized mode of life with regular hours is suitable to my personality						
20. I like to help my friends when they are in trouble ...						
21. I like to meet new people						
22. I am a very sociable person who gets along with nearly everyone						
23. I feel like making fun of people who do things that I regard as stupid						
24. It is safest to assume that all people have a vicious streak and it will come out when they are given a chance						
25. Guilt results of violation of God's law						
26. I like to keep my letters, bills, and other papers neatly arranged and filed according to some system ...						
27. I like to have my meals organized and a definite time set aside for eating						
28. Contributing to human welfare is the most satisfying human endeavor						
29. I feel at home with almost everyone and like to participate in what they are doing						
30. I like to criticize people who are in a position of authority						
31. Anyone who completely trusts anyone else is asking for trouble						
32. Marriage is the divine institution for the glorification of God						
33. I like to have my life so arranged that it runs smoothly and without much change in my plans						

	STRONGLY DISAGREE	DISAGREE	SLIGHTLY DISAGREE	SLIGHTLY AGREE	AGREE	STRONGLY AGREE
34. I like to help other people who are less fortunate than I am						
35. I like to start conversations						
36. Politicians have to bribe people						
37. No man can be fully successful in life without belief or faith in divine guidance						
38. I like to plan and organize the details of any work that I undertake						
39. I like to treat other people with kindness and sympathy						
40. I like to give lots of parties						
41. Most people can still be depended upon to see you through in a pinch						
42. Sin is but a cultural concept built by man						
43. I like to sympathize with my friends when they are hurt or sick						
44. I prefer to do things alone, rather than with my friends						
45. The dictates of one's religion should be followed with trusting faith						
46. I enjoy making sacrifices for the sake of happiness of others						
47. I think I have more friends than most people I know..						
48. There are some things which God will never permit man to know						
49. I like to do things with my friends rather than by myself						

APPENDIX A-2

Scoring the CST[a]

Each item of the CST was assigned a score from 1 for "Strongly Disagree" to 6 for "Strongly Agree." Items 42 and 44 were scored 6 to 1. The means for the six subtests were obtained and compared with the cutting points given below to determine the subject's system classification.

System 1 subjects were those who scored above 4.19 on the Divine Fate Control subtest.

System 2 subjects were those who scored as follows:

less than or equal to 4.19 on Divine Fate Control;
greater than 3.75 on Interpersonal Aggression;
and greater than 3.39 on General Pessimism.

System 3 subjects were those whose score pattern was:

less than or equal to 4.19 on Divine Fate Control;
less than or equal to 3.75 on Interpersonal Aggression;
and greater than 4.10 on Need for People.

System 4 subjects were those whose score pattern was:

less than or equal to 4.19 on Divine Fate Control;
less than or equal to 4.10 on Need for Structure-Order;
less than or equal to 4.10 on Need for People;
and less than or equal to 3.75 on Interpersonal Aggression.

[a]O. J. Harvey provided a copy of the CST and the scoring instructions provided here.

SIMILARITIES AMONG NATIONS

Form 1

Name ____________________________

Instructions

On the next two pages you will find a list of nation pairs which include all possible pairings of the ten countries listed below.

Australia	Red China
Brazil	Egypt
France	India
Cuba	Sweden
U.S.S.R.	U.S.A.

Beside each pair is a 7 point scale which runs from "Extremely Similar" to "Extremely Dissimilar". Place a check mark in the position on the scale which you feel best represents your opinion as to how similar or dissimilar the two nations are with respect to their basic characteristics.

For instance, if you think that the important characteristics of the paired nations are very much alike, place a mark under "Extremely Similar". But if you think that the paired nations are very different, then place a check mark under "Extremely Dissimilar". Where the two nations are about equal in differences and similarities, use the center of the scale, which is unmarked. There are 7 graduations of similarity, so try to make use of all 7 categories in making your judgements.

Do not spend too much time on any one of the pairs. Record your first impression. However, you may change a rating by erasing it and marking in your new opinion. There is no time limit.

TURN THE PAGE

Now rate each pair of nations as to their similarity on the 7-point scale.

Nation Pairs	SIMILAR EXTREMELY	QUITE	SLIGHTLY		SLIGHTLY	QUITE	DISSIMILAR EXTREMELY
1. Cuba - U.S.A.							
2. Australia - U.S.S.R.							
3. Australia - Sweden							
4. Red China - France							
5. U.S.S.R. - U.S.A.							
6. Australia - Brazil							
7. France - India							
8. U.S.A. - Red China							
9. India - Australia							
10. India - U.S.A.							
11. Egypt - U.S.A.							
12. U.S.S.R. - Egypt							
13. Cuba - Sweden							
14. Sweden - U.S.A.							
15. Australia - Red China							
16. Egypt - India							
17. Brazil - Cuba							
18. India - Brazil							
19. India - U.S.S.R.							
20. Brazil - Sweden							
21. Egypt - Sweden							

TURN THE PAGE

	SIMILAR: EXTREMELY	QUITE	SLIGHTLY		SLIGHTLY	QUITE	DISSIMILAR: EXTREMELY
22. Red China - U.S.S.R.							
23. Brazil - Red China							
24. Sweden - India							
25. Egypt - France							
26. Australia - Egypt							
27. Cuba - Red China							
28. U.S.A. - Australia							
29. France - U.S.A.							
30. Australia - Cuba							
31. France - Australia							
32. Brazil - U.S.S.R.							
33. Cuba - U.S.S.R.							
34. Red China - Egypt							
35. Brazil - France							
36. India - Cuba							
37. Sweden - Red China							
38. France - U.S.S.R.							
39. Egypt - Cuba							
40. Sweden - France							
41. Brazil - Egypt							
42. France - Cuba							
43. U.S.A. - Brazil							
44. Sweden - U.S.S.R.							
45. Red China - India							

END

INDIVIDUAL TOPICAL INVENTORY

INSTRUCTIONS

On the pages that follow there are 13 pairs of responses. Please select one response from each pair, the one that more accurately shows your opinion or feeling and record your choice on the answer sheet.

Be frank and indicate, in each case, your true feeling of opinion or the reaction which you would actually make in the situation. Do not indicate how you should feel or act; rather, indicate how you do feel and act.

Make sure that you are aware of the situation or topic that each pair of responses refers to.

1. Imagine that someone has criticized you. Choose the response from each pair that comes closest to your feelings about such criticism.

When I am criticized . . . .

A	Pair No.	B
I try to determine whether I was right or wrong. I examine my behavior to see if it was abnormal. Criticism usually indicates that I have acted badly and tends to make me aware of my own bad points.	(1)	It could possibly be that there is some misunderstanding about something I did or said. After we both explain our viewpoints, we can probably reach some sort of compromise.
It often has little or no effect on me. I don't mind constructive criticism too much, but I dislike destructive criticism. Destructive criticism should be ignored.	(2)	I try to accept and consider the criticism. Sometimes it has caused me to change myself; at other times I have felt that the criticism didn't really make much sense.

2. Imagine that you are in doubt. Choose the response from this pair that comes closest to your feelings about such doubt.

When I am in doubt . . . .

A	Pair No.	B
I become uncomfortable. Doubt can cause confusion and make one do a poor job. When one is in doubt he should ask and be sure of himself.	(3)	I find myself wanting to remove the doubt, but this often takes time. I may ask for help or advice if I feel that my questions won't bother the other person.

3. Imagine that a friend has acted differently toward you. Choose the response from each pair that comes closest to your feelings about such an action.

When a friend acts differently toward me . . . .

A	Pair No.	B
I am not terribly surprised because people can act in many different ways. We are different people and I can't expect to understand all his reasons for acting in different ways.	(4)	I am usually somewhat surprised but it doesn't bother me very much. I usually act the way I feel towards others. People worry too much about others' actions and reactions.
There has to be a definite reason. I try to find out this reason, and then act accordingly. If I'm right I'll let him know it. If he's wrong, he should apologize.	(5)	I usually let him go his way and I go mine. If a friend wants to act differently that's his business, but it's my business if I don't want to be around when he's that way.

A	(6)	B
I don't get excited. People change and this may cause differences. It is important to have friends, but you can't expect them to always be the same.		I like to get things back to normal as soon as possible. It isn't right friends to have differences between them. Whoever is at fault should straighten himself out.

4. Think about the topic of people in general. Choose the response from this pair that comes closest to your thoughts about people.

This I believe about people . . . .

A	Pair No. (7)	B
I can tell if I am going to get along with a person very soon after meeting him. Most people act either one way or another and usually it is not difficult to say what they are like.		It's hard for me to say what a person is like until I've known him a long time. People are not easy to understand and often act in unpredictable ways.

5. Think about the general topic of leaders. Choose the response from each pair that comes closest to your thoughts about leaders.

Leaders . . . .

A	Pair No. (8)	B
Leaders cannot provide all the answers. They are like other people--they have to try to figure out what action is necessary and learn from their mistakes.		Leaders make decisions sometimes without being sure of themselves. We should try to understand this and think of ways to help them out.

A	(9)	B
There are times when a leader shouldn't make decisions for those under him. The leader has the power to decide things, but each man has certain rights also.		A leader should give those under him some opportunity to make decisions, when possible. At times, the leader is not the best judge of a situation and should be willing to accept what others have to say.

6. Imagine that someone has found fault with you. Choose the response from each pair that comes closest to your feelings about such a situation.

When other people find fault with me . . . .

A	Pair No.	B
It means that someone dislikes something I'm doing. People who find fault with others are not always correct. Each person has his own ideas about what's right.	(10)	It means that someone has noticed something and feels he must speak out. It may be that we don't agree about a certain thing. Although we both have our own ideas, we can talk about it.
They have noticed something about me of which I am not aware. Although criticism may be hard to take, it is often helpful.	(11)	They are telling me something they feel is correct. Often they may have a good point which can help me in my own thinking. At least it's worthwhile to consider it.
I like to find out what it means; since people are different from one another, it could mean almost anything. A few people just like to find fault with others but there's usually something to be learned.	(12)	There is something to be changed. Either I am doing something wrong or else they don't like what I'm doing. Whoever is at fault should be informed so that the situation can be set straight.
I don't mind if their remarks are meant to be helpful, but there are too many people who find fault just to give you a hard time.	(13)	It often means that they're trying to be disagreeable. People get this way when they've had a bad day. I try to examine their remarks in terms of what's behind them.

APPENDIX A-5

Scoring the short ITI

A subject's score on the ITI was the total number of times that the alternative belonging to the more abstract system was chosen. A score on the short ITI could range from 0 to 13. Listed below are the letters corresponding to the more complex alternative for each item.

1.	B	8.	A
2.	B	9.	B
3.	B	10.	B
4.	A	11.	B
5.	B	12.	A
6.	A	13.	B
7.	B		

FOR THE SAKE OF ARGUMENT

Below are 17 pairs of statements, lettered A and B respectively. Select the one true statement of each pair (and only one) which you more strongly believe to be true. Record your choice by making an "X" in the appropriate space on the answer sheet.

There is no time limit, but work as quickly as you can.

1. A. Children get into trouble because their parents punish them too much.

   B. The trouble with most children nowadays is that their parents are too easy with them.

2. A. People's misfortunes result from the mistakes they make.

   B. Many of the unhappy things in people's lives are partly due to bad luck.

3. A. One of the major reasons why we have wars is because people don't take enough interest in politics.

   B. There will always be wars, no matter how hard people try to prevent them.

4. A. Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

   B. In the long run people get the respect they deserve in this world.

5. A. Capable people who fail to become leaders have not taken advantage of their opportunities.

   B. Without the right breaks one cannot be an effective leader.

6. A. No matter how hard you try some people just don't like you.

   B. People who can't get others to like them don't understand how to get along with others.

7. A. In the case of the well prepared student there is rarely if ever such a thing as an unfair test.

   B. Many times exam questions tend to be so unrelated to course work that studying is really useless.

8. A. Getting a good job depends mainly on being in the right place at the right time.

   B. Becoming a success is a matter of hard work, luck has little or nothing to do with it.

9. A. The average citizen can have an influence in government decisions.

   B. This world is run by the few people in power, and there is not much the little guy can do about it.

10. A. It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.

    B. When I make plans, I am almost certain that I can make them work.

11. A. As far as world affairs are concerned, most of us are the victims of forces we can neither understand, nor control.

    B. By taking an active part in political and social affairs the people can control world events.

12. A. It is usually best to cover up one's mistakes.

    B. One should always be willing to admit mistakes.

13. A. It is hard to know whether or not a person really likes you.

    B. How many friends you have depends upon how nice a person you are.

14. A. Most misfortunes are the result of a lack of ability, ignorance, laziness, or all three.

    B. In the long run the bad things that happen to us are balanced by the good ones.

15. A. Many times I feel that I have little influence over the things that happen to me.

    B. It is impossible for me to believe that chance or luck plays an important role in my life.

16. A. There's not much use in trying too hard to please people, if they like you, they like you.

    B. People are lonely because they don't try to be friendly.

17. A. Sometimes I feel that I don't have enough control over the direction my life is taking.

    B. What happens to me is my own doing.

NAME ____________________ FORM ARS

Please record your choice for each item by marking an "X" in the appropriate place.

	STRONGLY DISAGREE	DISAGREE	SLIGHTLY DISAGREE	NO ANSWER	SLIGHTLY AGREE	AGREE	STRONGLY AGREE
1. Let us eat, drink, and be merry, for tomorrow we die							
2. I tend to make decisions on the spur of the moment							
3. There are few things more satisfying than really to splurge on something - books, clothes, furniture, etc. ...							
4. Here today, gone tomorrow - that's my motto!							
5. Novelty has a great appeal to me							
6. My feelings about others fluctuate a good deal							
7. Conscience is another name for fear							
8. Movement, travel, change, excitement - that's the life for me							
9. I'm apt to really blow up, but it doesn't last long							
10. It's great fun just to mess around							
11. There's nothing so satisfying as really to tell someone off							
12. I really enjoy plenty of excitement							
13. One should not give free reign to the passions, but rather control and weigh them before expressing them							
14. I seldom, if ever lose my temper							
15. Uncontrolled impulsiveness is not part of my make-up							
16. It's hard to get me upset							
17. My speech is quite slow and deliberate							
18. I feel uncomfortable when people get too emotional							
19. I almost never respond impulsively to people or events ...							

APPENDIX A-8

Scoring the BABI

The letters on the answer sheet which corresponded to each of "theological" and "illness" choices are given below. A person's score on these scales was simply the sum of the values assigned each item on that scale. The Psychological Scale score was given by the formula, $P = 120 - (T + I)$.

	Theological Scale	Illness Scale
1.	B	C
2.	C	B
3.	A	C
4.	C	B
5.	A	B
6.	B	C
7.	A	C
8.	A	C
9.	C	A
10.	A	C
11.	B	C
12.	C	B
13.	B	C
14.	B	C
15.	C	A
16.	B	A
17.	C	A
18.	A	C
19.	A	B
20	B	A

BABI

Instructions

Read each of the twenty one (21) items in this inventory. For each item decide which of the three alternatives you most agree with or prefer, the alternative you take as a second choice and the alternative you least agree with.

Record your choices on the answer sheet only. Use the following code for answering:

Most agree:	3
Second choice:	2
Least agree:	1

For each item, the three alternatives must be ranked.

Example:

Answer Sheet

	A	B	C
1.	(2)	(3)	(1)

This indicates that the person who answered most agrees with or likes alternative (B) to which he has given the rank of three. He takes alternative (A) as a second choice and he least prefers alternative (C).

1. Being very aggressive and domineering:

A. is a result of one's life experience
B. is caused by a lack of harmony with God's will; sinfulness
C. is caused by what could be the beginning of a degree of mental illness

2. Being overly critical of others is one of the outcomes of:

A. the experiences some people have had
B. a certain degree of mental illness or disorder
C. moral weakness, lack of harmony with God

3. Frequent sexual behavior before or outside marriage is:

A. the result of a lack of proper use of one's will power
B. a way of behaving which was learned
C. caused by what is really a kind of disordered thinking; social illness

4. People who have very strong unfounded fears are best regarded as:

A. people who are using ineffective ways of reacting to things or other people
B. sick, at least to some degree
C. fellow humans who need the help of God

5. Very frequent indecisiveness is caused by:

A. weak will
B. a very minor sort of mental illness
C. the person's background of learning

6. People who are very over-confident are best regarded as:

A. using ineffective behavior
B. people who have gone astray; weak willed
C. being, in a way, sick

7. Feelings of despondency and lack of hope are caused by:

A. a lack of harmony with the peace which God offers his people
B. what we have learned
C. the beginnings of what could be mental illness

8. People who are very aggressive are best regarded as:

A. fellow humans who have gone astray
B. people using ineffective behavior
C. showing signs of possible mental disorder

9. When we see people who have strong feelings of despondency and lack of hope, it is best to regard them as:

A. sick, although not always physically
B. people who are not using effective behavior
C. fellow humans who need a stronger faith

10. People who are sexually promiscuous are best regarded as:

A. sinful, but still humans like us
B. using inappropriate behavior
C. showing signs of what could be considered potential mental illness of some degree

11. Being very over-critical is:

A. a more extreme case of the way most of us are
B. a bad way to behave, even sinful
C. quite clearly related to a kind of mental illness

12. People who are very suspicious are best regarded as:

A. using ineffective behavior
B. somewhat sick
C. having a bad, even sinful, habit

13. Excessive and unfounded self-confidence

A. is a result of the person's past experiences; of his learning
B. is a result of a lack of harmony with God
C. is a result of mental illness of at least some minor degree

14. Being very suspicious is one of the outcomes of:

A. the various experiences the person has had
B. a lack of harmony with God's will
C. a certain degree of mental disorder or illness

15. People who very often feel guilty are best regarded as:

A. somewhat sick, maybe showing signs of what could be mental illness
B. people who are unable to use more effective and successful ways of behaving
C. people who have lost the peace of God

16. Excessive use of alcoholic beverages:

A. is an illness like any other illness
B. is sinful, but we can still be kind
C. is a way some people learn to live

17. People who are very frequently indecisive are best regarded as:

A. sick, (mentally), at least to some degree
B. using ineffective behavior
C. fellow human beings who need a stronger faith

18. Very strong unfounded fears are caused by:

A. a lack of harmony with God's will
B. the ways we have learned to feel about things
C. what could be an illness

19. Persistant feelings of guilt are:

A. the result of immoral behavior
B. caused by some degree of mental illness
C. caused by what the person had learned through life

20. Over-aggressiveness and domineering behavior is best changed by:

A. treatment
B. prayer
C. re-education

FORM RO

The following items deal with various types of religious ideas and social opinions. We should like to find out how common they are.

For each of the twenty items, please indicate the response you prefer. Record your choice by marking in the appropriate space on the answer sheet.

If none of the choices expresses exactly how you feel, then indicate the one which is closest to your own views. If no choice is possible, you may omit the item.

There are no "right" or "wrong" choices. There will be many religious people who will agree with all the possible answers.

1. A primary reason for my interest in religion is that my church is a congenial social activity.

   a. definitely not true of me

   b. tends not to be true

   c. tends to be true

   d. definitely true of me.

2. Religion is especially important to me because it answers many questions about the meaning of life.

   a. definitely disagree

   b. tend to disagree

   c. tend to agree

   d. definitely agree

3. One reason for my being a church member is that such membership helps to establish a person in the community.

   a. definitely not true

   b. tends not to be true

   c. tends to be true

   d. definitely true

4. The prayers I say when I am alone carry as much meaning and personal emotion as those said by me during servies.

   a. almost never

   b. sometimes

   c. usually

   d. almost always

5. Although I believe in my religion, I feel there are many more important things in my life.

   a. I definitely disagree

   b. I tend to disagree

   c. I tend to agree

   d. I definitely agree

6. It doesn't matter so much what I believe so long as I lead a moral life.

   a. I definitely disagree

   b. I tend to disagree

   c. I tend to agree

   d. I definitely agree

7. It is important to me to spend periods of time in private religious thought and meditation.

   a. frequently true

   b. occasionally true

   c. rarely true

   d. never true

8. What religion offers me most is comfort when sorrows and misfortune strike.

   a. I definitely disagree

   b. I tend to disagree

   c. I tend to agree

   d. I definitely agree

9. My religious beliefs are what really lie behind my whole approach to life.

   a. this is definitely not so

   b. probably not so

   c. probably so

   d. definitely so

10. The church is most important as a place to formulate good social relationships.

   a. I definitely disagree

   b. I tend to disagree

   c. I tend to agree

   d. I definitely agree

11. The primary purpose of prayer is to gain relief and protection.

   a. I definitely agree

   b. I tend to agree

   c. I tend to disagree

   d. I definitely disagree

12. If not prevented by unavoidable circumstances, I attend church:

   a. more than once a week

   b. about once a week

   c. two or three times a month

   d. less than once a month

13. The purpose of prayer is to secure a happy and peaceful life.

   a. I definitely disagree

   b. I tend to disagree

   c. I tend to agree

   d. I definitely agree

14. I read literature about my faith (or church).

a. frequently

b. occasionally

c. rarely

d. never

15. Quite often I have been keenly aware of the presence of God or the Divine Being.

a. definitely not true

b. tends not to be true

c. tends to be true

d. definitely true

16. Although I am a religious person I refuse to let religious considerations influence my everyday affairs.

a. definitely not true of me

b. tends not to be true

c. tends to be true

d. clearly true in my case

17. Occasionally I find it necessary to compromise my religious beliefs in order to protect my social and economic well-being.

a. definitely disagree

b. tend to disagree

c. tend to agree

d. definitely agree

18. If I were to join a church group I would prefer to join (1) a Bible Study group or (2) a social fellowship.

a. I would prefer to join (1)

b. I probably would prefer (1)

c. I probably would prefer (2)

d. I would prefer to join (2)

19. I pray chiefly because I have been taught to pray.

a. definitely true of me

b. tends to be true

c. tends not to be true

d. definitely not true of me

20. I try hard to carry my religion over into all my other dealings in life.

a. I definitely disagree

b. I tend to disagree

c. I tend to agree

d. I definitely agree

APPENDIX A-11

Scoring the ROS

The ROS is scored in the following manner:

1. Each item is given a value of 1, 2, 4, or 5 with intrinsic responses receiving low scores. Unanswered items are given a score of 3.

2. To obtain the intrinsic score all items on the Intrinsic Scale are summed. These items are identified below by an "I." Scores range from 9 to 45 with low scores representing high intrinsicness.

3. To obtain the extrinsic score all 11 items on the Extrinsic Scale are summed. These items are identified below by an "E." High scores represent high extrinsicness.

4. In order to classify a subject as an intrinsic or extrinsic individual the medians for the I and E scales are obtained. Subjects above the median on both scales are considered extrinsic while those falling below are classified as intrinsic.

5. Indiscriminately pro-religious types are those with an I score that is 12 or more points <u>less</u> than their E score.

6. Indiscriminately anti-religious types are those with an I score that is 12 or more points <u>greater</u> than their E score.

The I and E scale items are identified as follows:

1.	E	8.	E	15.	I
2.	I	9.	I	16.	E
3.	E	10.	E	17.	E
4.	I	11.	E	18.	I
5.	E	12.	I	19.	E
6.	E	13.	E	20.	I
7.	I	14.	I		

APPENDIX B

APPENDIX B-1 Trial Means and Standard Deviations for Order by Rules and Problems.

APPENDIX B-2 Analysis of Variance for Trial Data.

APPENDIX B-3 Means and Standard Deviations for Time in Seconds to Solution by Order for Rules and Problems.

APPENDIX B-4 Analysis of Variance for Time to Solution.

APPENDIX B-5 Means and Standard Deviations for Mean Response Time in Seconds by Order for Rules and Problems.

APPENDIX B-6 Analysis of Variance for Mean Response Time.

APPENDIX B-7 Means and Standard Deviations for Complexity Tests and their Correlates.

APPENDIX B-8 Correlations Among Rules (Problem 1) for Different Measures.

APPENDIX B-1

TRIAL MEANS AND STANDARD DEVIATIONS FOR ORDER BY RULES AND PROBLEMS

	Order 1[a]		Order 2		Order 3		Order 4		Order 5		Order 6	
Rule	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Inclusive Disjunctive												
Problem 1	28.08[b]	11.15	24.58	7.20	18.08	3.15	22.33	5.99	19.67	5.02	26.50	18.04
Problem 2	23.75	16.34	20.83	9.11	19.08	4.89	19.58	4.93	16.92	1.78	20.75	11.73
Problem 3	21.58	7.77	22.33	11.71	16.08	.29	17.33	1.83	17.42	2.27	18.08	7.22
Joint Denial												
Problem 1	21.58	6.89	22.83	7.41	44.42	28.50	60.42	37.44	23.08	7.06	27.67	13.72
Problem 2	17.33	2.50	19.25	5.86	21.42	7.44	24.42	19.91	16.83	1.80	18.50	4.34
Problem 3	20.42	7.34	16.75	2.01	17.25	2.38	20.08	6.68	16.08	.29	17.58	4.30
Biconditional												
Problem 1	44.67	31.48	40.92	25.41	35.92	20.35	40.92	26.53	47.17	29.03	66.83	43.57
Problem 2	21.58	6.61	19.67	4.72	24.42	17.79	20.83	6.13	20.83	7.09	36.83	28.76
Problem 3	19.83	6.53	22.42	10.17	18.00	3.54	25.75	23.51	19.00	3.45	18.17	3.76

[a] If the inclusive disjunction is given number 1, joint denial number 2, and biconditional number 3, the orders are respectively 123, 132, 213, 231, 312, and 321. Thus, order 6 is biconditional, joint denial, and disjunction.

[b] N for each mean is 12.

APPENDIX B-2

ANALYSIS OF VARIANCE FOR TRIAL DATA

Source	df	MS	F	P
Between subjects				
Complexity level (A)	3	80.48	.230	NS
Order of rules (B)	5	693.99	1.983	NS
A x B	15	287.10	.820	NS
Error	48	349.94		
Within subjects				
Rules (C)	2	5138.70	19.019	$<.0001$
A x C	6	86.31	.320	NS
B x C	10	989.87	3.664	$<.0004$
A x B x C	30	255.17	.944	NS
Error	96	270.18		
Problems (D)	2	14046.00	85.37	$<.0001$
A x D	6	26.22	.160	NS
B x D	10	318.74	1.937	.0491
A x B x D	30	175.91	1.069	NS
Error	96	164.53		
C x D	4	2440.50	11.404	$<.0001$
A x C x D	12	157.80	.737	NS
B x C x D	20	503.72	2.354	$<.0015$
A x B x C x D	60	223.19	1.043	NS
Error	192	214.01		

APPENDIX B-3

MEANS AND STANDARD DEVIATIONS FOR TIME IN SECONDS TO SOLUTION BY ORDER FOR RULES AND PROBLEMS

	Order 1[a]		Order 2		Order 3		Order 4		Order 5		Order 6	
Rule	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Inclusive Disjunction												
Problem 1	195.2[b]	86.7	137.9	57.7	62.7	22.9	77.3	41.5	73.2	37.9	90.4	68.6
Problem 2	77.7	59.5	75.8	51.6	55.7	29.9	47.5	13.1	46.6	18.4	56.8	72.5
Problem 3	71.10	30.6	70.9	41.8	39.0	10.9	41.7	12.2	48.3	13.5	43.7	34.3
Joint Denial												
Problem 1	88.6	50.3	92.1	49.9	253.5	178.0	460.9	416.8	77.0	33.7	108.8	49.6
Problem 2	56.5	31.3	53.4	31.9	84.5	47.8	94.9	74.1	46.3	15.8	66.3	45.3
Problem 3	60.7	34.3	38.3	16.4	54.2	17.2	72.5	37.1	42.5	16.8	47.8	18.1
Biconditional												
Problem 1	281.0	279.8	230.0	203.5	130.4	81.6	134.9	63.4	238.3	120.2	379.8	277.1
Problem 2	86.7	67.2	78.6	25.1	74.6	72.1	69.4	35.2	76.9	24.7	144.3	78.6
Problem 3	90.7	63.8	91.0	50.6	49.5	16.8	86.9	81.7	68.0	17.6	67.7	26.5

[a]See Appendix B-1 for description of meaning of order.

[b]N = 12 for each mean.

APPENDIX B-4

ANALYSIS OF VARIANCE FOR TIME TO SOLUTION

Source	df	MS	F	P
Complexity level (A)	3	6385.2	.406	NS
Order of rules (B)	5	26616.0	1.692	NS
A x B	15	15312.0	.973	NS
Error	48	15734.7		
Rules (C)	2	190,396.0	16.066	<.0001
A x C	6	5554.2	.469	NS
B x C	10	93052.0	7.852	<.0001
A x B x C	30	8494.7	.717	
Error	96	11850.9		
Problems (D)	2	829,340.0	86.148	<.0001
A x D	6	3596.0	.374	NS
B x D	10	12687.0	1.318	NS
A x B x D	30	7674.3	.797	NS
Error	96	9626.9		
C x D	4	64112.0	7.476	<.0001
A x C x D	12	4022.1	.469	NS
B x C x D	20	50281.0	5.863	<.0001
A x B x C x D	60	7135.5	.832	NS
Error	192	8576.1		

APPENDIX B-5

MEANS AND STANDARD DEVIATIONS FOR MEAN RESPONSE TIME IN SECONDS BY ORDER FOR RULES AND PROBLEMS

Rule	Order 1[a] Mean	Order 1[a] S.D.	Order 2 Mean	Order 2 S.D.	Order 3 Mean	Order 3 S.D.	Order 4 Mean	Order 4 S.D.	Order 5 Mean	Order 5 S.D.	Order 6 Mean	Order 6 S.D.
Inclusive Disjunction												
Problem 1	7.13[b]	2.36	5.59	1.72	3.42	1.20	3.37	1.42	3.49	0.92	3.32	1.28
Problem 2	3.18	0.96	3.43	0.86	2.83	1.29	2.42	0.58	2.59	0.66	2.28	1.06
Problem 3	3.28	1.28	3.15	0.88	2.39	0.69	2.36	0.69	2.80	0.79	2.22	0.80
Joint Denial												
Problem 1	3.94	1.55	3.96	1.28	6.32	2.12	7.57	5.77	3.28	0.88	4.39	2.48
Problem 2	3.10	1.74	2.62	0.69	3.73	1.21	4.03	1.92	2.70	0.89	3.64	2.75
Problem 3	2.85	0.93	2.27	1.01	3.14	1.15	3.54	1.44	2.60	1.06	2.65	0.61
Biconditional												
Problem 1	5.63	3.00	5.03	1.59	3.64	1.23	3.73	1.37	5.57	2.95	5.63	2.17
Problem 2	3.68	1.62	3.97	0.96	2.85	0.88	3.22	0.91	3.71	0.72	4.92	3.41
Problem 3	4.41	2.34	4.05	1.18	2.68	0.67	3.33	1.04	3.55	0.70	3.84	1.82

[a] See Appendix B-1 for description of meaning of order.

[b] N = 12 for each mean.

APPENDIX B-6

ANALYSIS OF VARIANCE FOR MEAN RESPONSE TIME

	df	MS	F	P
Complexity level (A)	3	16.550	1.750	NS
Order of rules (B)	5	8.089	.855	NS
A x B	15	9.713	1.027	NS
Error	48	9.457		
Rules (C)	2	34.587	12.149	$<$.0001
A x C	6	4.094	1.438	NS
B x C	10	28.517	10.106	$<$.0001
A x B x C	30	1.845	.648	NS
Error	96	2.847		
Problems (D)	2	176.460	81.179	$<$.0001
A x D	6	2.479	1.141	NS
B x D	10	2.595	1.194	NS
A x B x D	30	2.411	1.109	NS
Error	96	2.174		
C x D	4	3.172	2.217	NS
A x C x D	12	2.090	1.461	NS
B x C x D	20	5.968	4.172	$<$.0001
A x B x C x D	60	1.596	1.116	NS
Error	192	1.431		

APPENDIX B-7

MEANS AND STANDARD DEVIATIONS FOR COMPLEXITY TESTS AND THEIR CORRELATES

Test[a]	Means	S.D.
Divine Fate Control	3.71	1.17
Need for Structure-Order	4.51	0.72
Need to Help People	4.60	0.62
Need for People	4.36	0.65
Interpersonal Aggression	2.89	0.96
General Pessimism	3.47	0.78
CST subtests (3)	11.69	1.73
CST subtests (total)	23.55	2.18
Conceptual Systems Test	2.07	1.03
Interpersonal Topical Inventory	7.84	1.89
Similarities Among Nations Test	4.18	2.26
Dimensions (SANT)	2.93	0.63
Internal-External Scale	7.24	2.79
BABI Theological Scale	35.20	6.42
BABI Illness Scale	36.58	7.23
BABI Psychological Scale	48.18	6.19
Agreement Response Scale	81.12	13.54
CAAT Verbal Scale	30.60	6.91

[a]N = 137

APPENDIX B-7 (continued)

Test	Means	S.D.
CAAT Numerical Scale	36.25	5.61
CAAT Total	66.93	10.55
ROS Intrinsic subtest	28.57	8.87
ROS Extrinsic subtest	30.18	6.45
<u>Myers-Briggs Type Indicator</u>		
Extraversion-Introversion	95.88	24.46
Sensation-Intuition	94.23	27 98
Thinking-Feeling	109.73	21.88
Judging-Perceiving	105.36	30.41

APPENDIX B-8

CORRELATIONS AMONG RULES (PROBLEM 1) FOR DIFFERENT MEASURES[a]

Measures	1	2	3	4	5	6	7	8	9	10	11
1. Disjunction (trials)											
2. Disjunction (errors)	901[b]										
3. Disjunction (time)	690	645									
4. Disjunction ($\bar{x}$ time)	144	197	765								
5. Joint Denial (trials)	035	079	-150	-203							
6. Joint Denial (errors)	-000	018	-167	-213	907						
7. Joint Denial (time)	-045	082	-029	013	719	652					
8. Joint Denial ($\bar{x}$ time)	-139	-013	023	161	231	261	786				
9. Biconditional (trials)	-100	071	035	-033	-179	-155	-156	-107			
10. Biconditional (errors)	161	110	094	-020	-156	-136	-163	-122	937		
11. Biconditional (time)	043	017	158	206	-222	-223	-148	-039	838	858	
12. Biconditional ($\bar{x}$ time)	079	-029	201	389	-185	-217	-070	044	084	161	532

[a]Decimals dropped.

[b]With $N = 72$ all correlations $\geq .230$ are significant ($p \leq .05$).